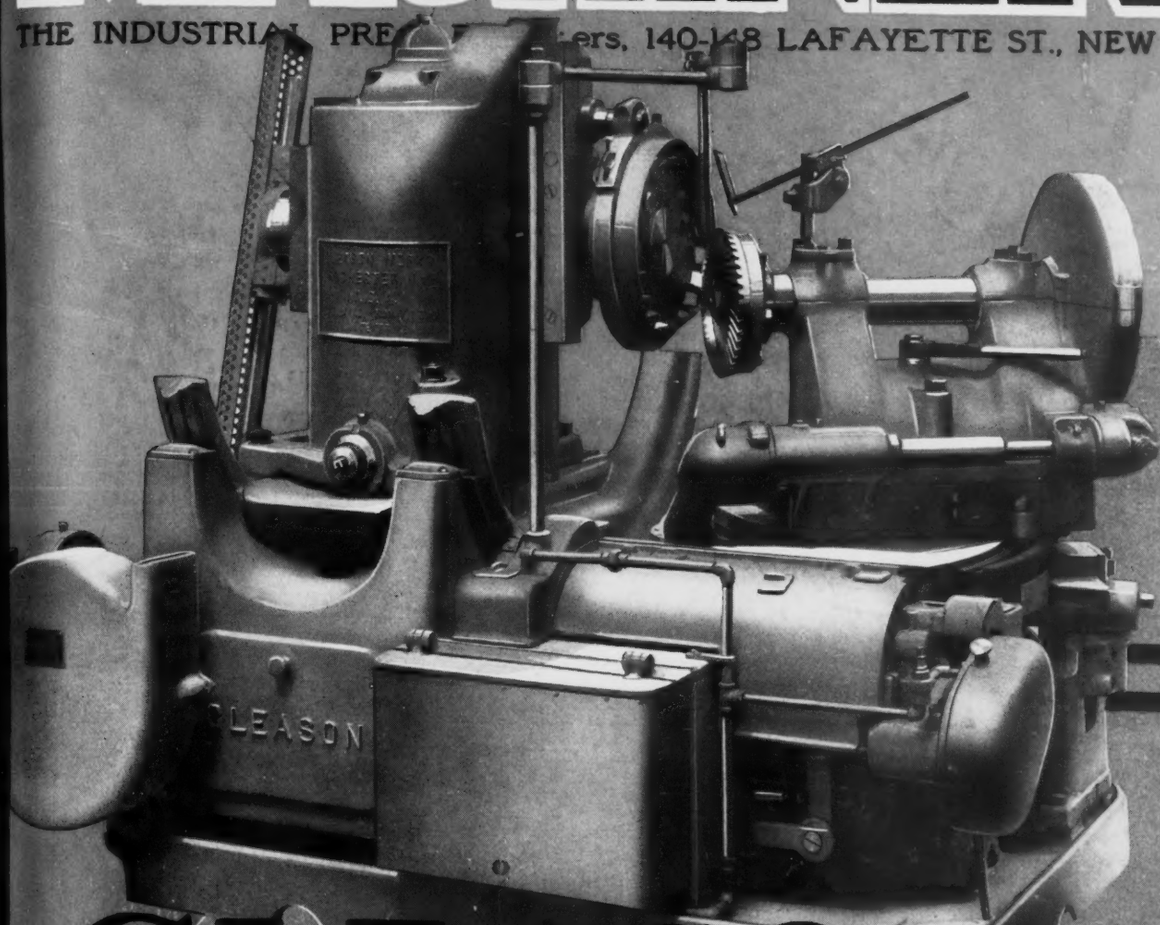
Volume 30 APRIL, 1924 Number 8

MACHINERY

THE INDUSTRIAL PRESS, Publishers, 140-148 LAFAYETTE ST., NEW YORK



GLEASON

15" Spiral Bevel Gear Generator

Produces Spiral Bevel Gears up to 19½" diameter and 3 D.P. quickly and accurately.

Can also be used to advantage in cutting the mating pinions.

It is fully automatic and strictly a machine for quantity production.

Our descriptive leaflet will be sent upon request.

GLEASON WORKS, Rochester, N. Y., U. S. A.

GLEASON

TRADE MARK
BRISTO Safety Set Screws
REG. U.S. PAT. OFFICE

Why Are T-Slots in Machine Tables?

To hold the work of course. And for the same reason we put dove-tailed flutes in Bristo Set Screws—to hold the wrench.

A Bristo Wrench simply cannot slip, and it *will* tighten; because the dove-tailed flutes, so like the T-slots in the table, hold the wrench beyond any chance of slipping.

No obtuse angles to wear down until the wrench wobbles; instead, there are six steel fingers which grasp the set screw so that it can be tightened as a set screw *'ought* to be tightened!

Long life and better, safer service—that's what you buy with every Bristo Safety Set Screw.

May we have your address—for Bulletin and free samples?

THE BRISTOL COMPANY
WATERBURY, CONNECTICUT



SIMONDS HACK SAW BLADES

"Quality Guaranteed by the Name"

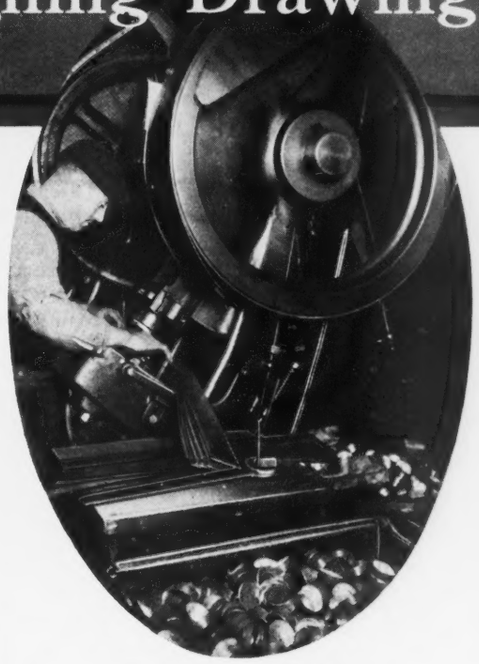
More production and longer service at a minimum cost are features which recommend ***Simonds Hack Saw Blades*** for use in Machine Shops. Made of high grade tungsten steel and heat-treated by a special Simonds process, Simonds Hack Saw Blades do not break or shell teeth under severe cutting tests. They are made for machine or hand use.

WRITE FOR CATALOG AND PRICES

SIMONDS SAW and STEEL COMPANY

5 Factories Fitchburg, Mass. Chicago, Ill. 14 Branches

Designing Drawing Dies



By EDWARD HELLER

THE process known as "drawing," when applied to the manufacture of certain automobile parts, kitchen utensils, and various electrical appliances, has, generally speaking, very few limitations. Shells can be drawn as large in diameter and as deep as the size of the largest available press will permit, and as small in diameter as a tool-steel drawing punch can be made that will withstand the service. However, certain factors must be taken into consideration in designing dies for drawing light weight metal. For instance, the radius *R*, Fig. 1 (see also radius *A* in the illustration accompanying Table 1) over which a shell can be drawn, has a direct relation to the gage of the metal. This radius, if too large, would start wrinkles in the shell that would be difficult to remove, while if too small, the metal might break in sliding over the corner on account of excessive friction. The same restrictions apply in a certain sense to the radius *B* (see illustration in table) at the bottom of the shell.

Radii over which Metal can be Drawn

A radius that is too large will cause wrinkles (as previously stated) from the bottom to the top of the work, while too sharp a corner might cause the punch to break through the bottom. As a general rule, the radius at the top or bottom has nothing to do with the diameter of the shell; nevertheless, it is customary in most shops to make the radii for large-diameter shells larger than for shells of smaller diameter. This is usually done either for the sake of appearance or because it facilitates later operations, such as beading. However, care must be taken not to use too much freedom in this respect, as the radii should be governed largely by the gage of the metal. Table 1 can be used as a guide in determining the maximum and minimum radii that will produce satisfactory results.

Type of Equipment Used

The toggle press, with its long stroke and wide range of adjustment, is well adapted for the production of kitchen utensils. In Fig. 1 is shown a typical drawing die for a press of this kind. This die is used in the first drawing operation. It consists of three units, namely, the punch *A*, blank-holder *B*, and lower die member *C*. The work in this case may be carried completely through the die and be stripped from the punch as the latter ascends. A set of tools for a finish-drawing operation includes also the knock-out *D*, which requires that the die *C* be made somewhat higher for the same depth of shell.

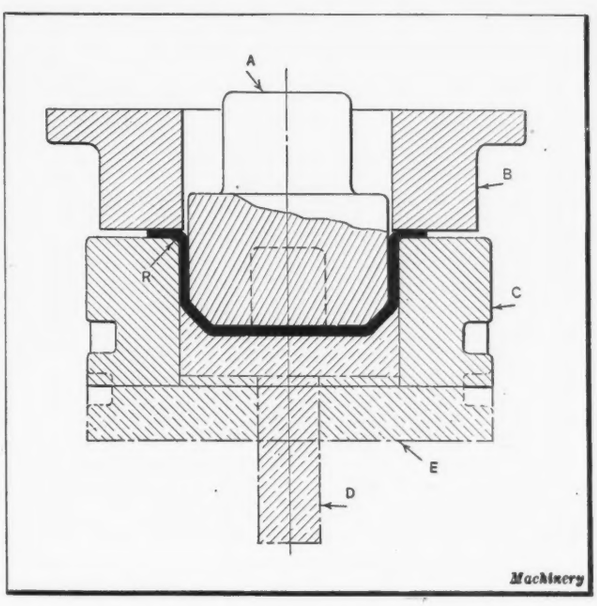


Fig. 1. Type of Die used on Toggle Press for First Drawing Operation on Such Products as Kitchen Utensils

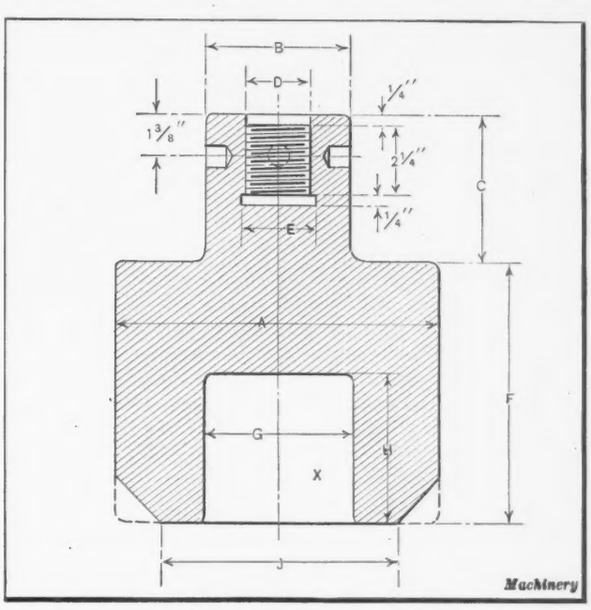


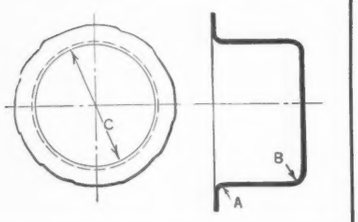
Fig. 2. Diagram used to illustrate Method of determining Dimensions of Drawing Punch of Type shown in Fig. 1

This additional height is obtained by changing the base, as indicated by the dot-and-dash cross-sectioning at *E*.

Operation of Drawing Die

The action of a set of tools of the type shown in Fig. 1 is as follows: The blank, which is cut to the required size on a different machine, is placed on the die against gage pins which locate it in the proper position. Then the press is started, and the blank-holder *B* comes down on the blank, holding it with the required pressure. The punch, which is already under way, draws the metal down into the die and forms the shell. It then starts up again, and about the time that it is entirely out of the shell, the blank-holder begins to ascend. A little later the knock-out mechanism moves upward and brings the shell to the top of the die ready for the operator to replace it by a blank. This completes the cycle. The operation is repeated over and over again at the rate of 400 to 600 times an hour. On small work, where the operator can grip either the blank or the shell in one hand, the press is usually run continuously, while on large work, it is started and stopped at each cycle.

TABLE 1. MAXIMUM AND MINIMUM RADII FOR DIFFERENT GAGES OF METAL



U. S. Gage	Thickness, Inches	Radius A, Minimum, Inch	Radius A, Maximum, Inch
16	0.0625	1/4	3/8
17	0.0563	1/4	3/8
18	0.0500	1/4	3/8
19	0.0438	3/16	5/16
20	0.0375	3/16	5/16
21	0.0344	3/16	5/16
22	0.0313	3/16	5/16
23	0.0281	3/16	9/32
24	0.0250	3/16	9/32
25	0.0219	3/16	9/32
26	0.0188	5/32	1/4
27	0.0172	5/32	1/4
28	0.0156	5/32	1/4

Machinery

Tools or dies of the type just described, when used for shells of steel or aluminum of gages ranging from 28 to 16, are usually made according to empirical formulas. The general method of designing a round punch may be made clear by reference to Fig. 2. The term "diameter," when used in reference to a drawn shell always means the inside diameter, and for this reason the diameter *A* of the punch is the basic dimension from which other dimensions are determined. The diameter *B* of the stem is made from 2 to 5 inches, depending on the size of the punch proper. There are cases, however, where the stem diameter is larger than the drawing part of the punch, but those are special cases. The length *C* of the stem varies slightly with the diameter *B*, but this is arbitrary and not very important.

The size of the tapped hole *D* is determined by, or rather made to suit, the diameter *B*. This is necessary, as too big a hole in the stem will weaken the punch at that point. The tapped hole *D* does not necessarily have to fit the ram of the press. It is much better to standardize this hole and make an adapter, such as shown in Fig. 3, for each press. In this manner any punch can be used on any press, regardless of the size of the thread on the ram. The dimension *E*, Fig. 2, for the tool clearance groove depends, of course, on the depth of the thread.

The length *F* of the punch is made 2½ inches longer than the shell that results from the drawing operation. This factor is used in order to insure that a part of the punch will project from the shell at the end of the drawing stroke. On the first or intermediate drawing operations, the height of the shell is usually estimated. The length of a shell of

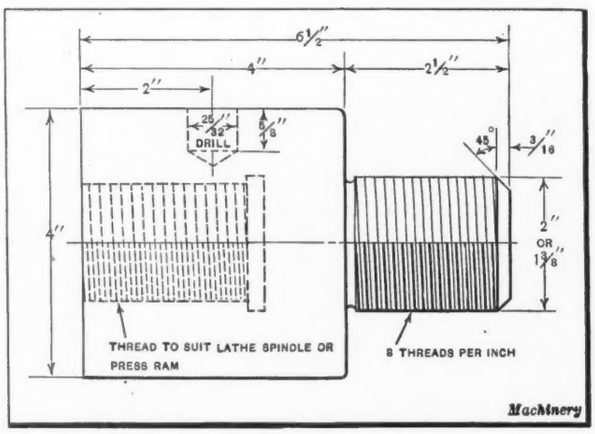


Fig. 3. Adapter for holding Punches Such as the One shown in Fig. 2, in a Lathe Spindle or Press Ram

average dimensions can usually be estimated within ½ inch, and the allowance of 2½ inches is therefore sufficient for all practical purposes. When a punch is 8 inches or over in diameter and the length *F* is 6 inches or more, the punch is not made solid, but a hole *X* is cored out. The diameter *G* of the core is made 5 inches less than the punch diameter, and the depth *H*, 2½ inches less than the length *F*, leaving a thickness of metal all around and on the top of 2½ inches. This construction is sufficiently strong for drawing 16-gage steel and for much heavier gages in the softer metals.

The bottom of the punch used for the final draw must, of course, suit the requirements of the job, but this is not the case on the preliminary operations. In practically all cases, the end of the punch is beveled, so that *J* is equal to the diameter of the shell as it is expected to be after the succeeding drawing operation is performed. This feature, together with the bevel *C* in the die used for the succeeding draw (Fig. 4) helps to center the shell.

A punch of this type is usually made of semi-steel—a mixture of pig iron with about 15 per cent of steel scrap. This makes a casting with a very tough surface. Care must

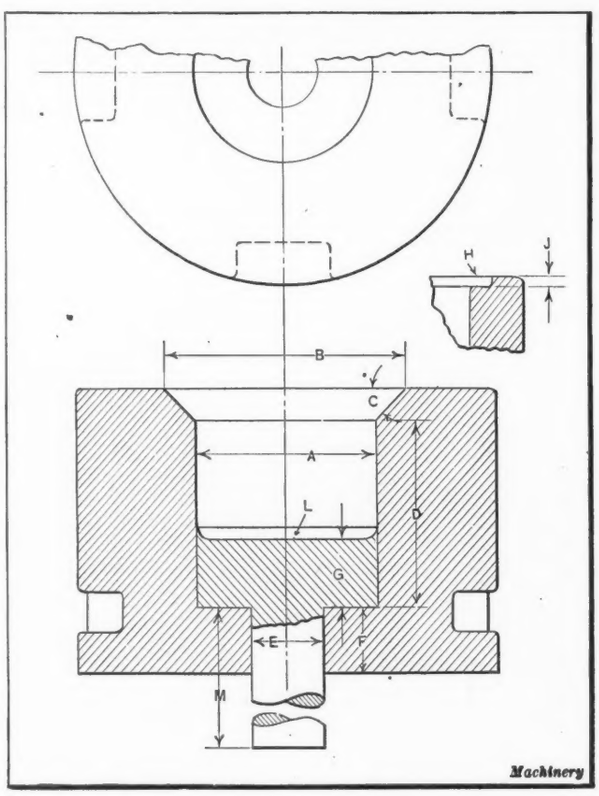
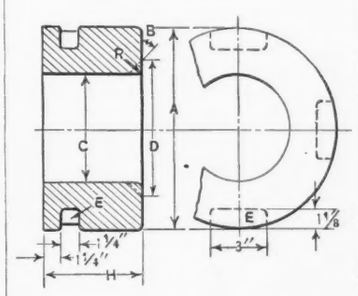


Fig. 4. Type of Die used for Final Drawing Operation

be taken not to make the pattern with too great an allowance for finishing, as an extra heavy cut will remove the tough surface and expose the spongy core (which is full of blow-holes and other defects).

In rare cases a punch for a final drawing operation is made of good tool steel. This is done on jobs that require a spinning operation to remove wrinkles after the final draw, and where the number of pieces to be produced is not very large. In such a case the punch is used as a spinning mandrel after the drawing operation is completed, thus saving the cost of a spinning chuck. Ordinarily such a saving is possible only in a shop where both the threaded holes in the spinning chucks and draw punches are standardized. This is another point in favor of the adapter shown in Fig. 3 as by the use of this device any spinning lathe or draw press can be used with any chuck or punch.

TABLE 2. DATA FOR FIRST-OPERATION DIE



Gage	Thickness, Inches	K
16	0.0625	0.148
17	0.0563	0.135
18	0.0500	0.122
19	0.0438	0.109
20	0.0375	0.095
21	0.0344	0.087
22	0.0313	0.079
23	0.0281	0.072
24	0.0250	0.065
25	0.0219	0.060
26	0.0188	0.050
27	0.0170	0.045
28	0.0156	0.040

Dimension A = blank diameter + 2 inches.
Dimension C = punch diameter + amount given in column K.
Height H = estimated height of shell + 2½ inches.

MacMinery

Design of First-operation Die

A typical round die for a first-drawing operation is shown in the illustration accompanying Table 2. The inside diameter is equal to the punch diameter plus a constant *K* given in the right-hand column of the table. This constant is equal to twice the thickness of the metal plus an allowance for clearance and for any variation in the thickness of the metal. It will be noticed that this allowance runs from 0.009 inch for 28-gage metal to 0.023 inch for 16-gage metal. The values given in the table for *K* have been found to give good results in practice for the specified gages. The outside diameter *A* of the die is made 2 inches larger than the blank diameter. This provides sufficient supporting metal for the blank-locating gage pins which are usually of the disappearing type. The height *H* is made 2½ inches greater than the estimated height of the shell, so that there is sufficient space to allow a wooden knock-out block to be placed in the die. This block is actuated by the knock-out mechanism of the press, and it, in turn, lifts the shell out on the up stroke of the ram. The radius *R* is determined from the gage of the metal, as indicated in Table 1.

For intermediate draws, the same type of die is used, with the exception that the corner *R* is beveled to an angle *B* (see illustration with Table 2) which is usually 45 degrees and so made that *D* is equal to the diameter of the shell produced in the previous draw. The outside diameter *A* for an intermediate drawing die is determined from the inside diameter, being made 6 inches larger than the shell diameter.

The dies are usually made with four cored pockets *E*, which provide means of fastening the die to the press bed or bolster plate. In the case of small work, it is sometimes advisable to make the die with a flanged base, which can be used for fastening it to the press bed. Toggle presses are usually provided with large clearance holes in the bed, and the flange on a small die must, of course, be wide enough to more than cover the clearance hole.

Die for Final Drawing Operation

Fig. 4 shows the design of a die employed for the final drawing operation. The die is the same in all respects as the one shown in the illustration accompanying Table 2, except that it has a bottom which supports a metal knock-out. The diameter *A* is determined from the punch, as previously described. Dimension *B* and angle *C* are determined by the size of the shell to be drawn. Height *D* is made to meet the special requirements of the job and is equal to the sum of the finished height of the shell plus the thickness *G* of the knock-out. The diameter *E* of the hole for the knock-out stem need not be greater than 2½ inches; dimension *F* should not be less than 2 inches, and when space will permit, it is best to make this dimension about 2½ inches. It is better to shorten some other part than to make *F* less than 2 inches.

The shell produced in the die shown in Fig. 4 will have a flange which slopes up at an angle *C*. Sometimes this is not desirable, as in the case of shells of small diameter which are made of heavy stock and which are to be beaded; it will be apparent that in work of this nature a great deal

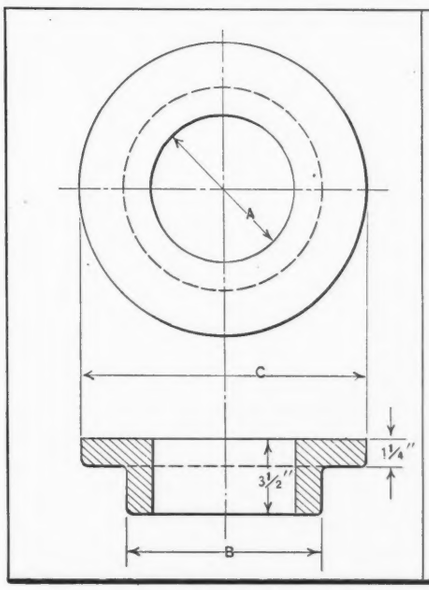


Fig. 5. Blank-holder used for First Drawing Operation

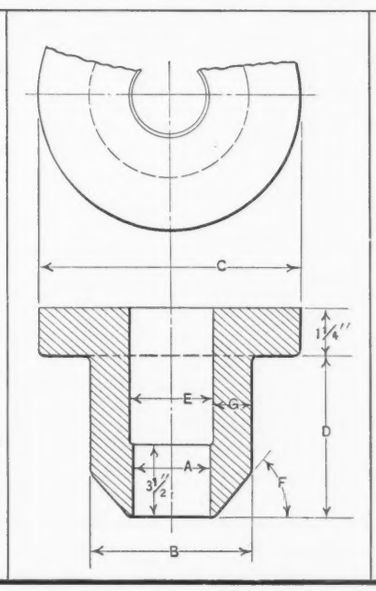


Fig. 6. Blank-holder for All Operations after Initial Draw

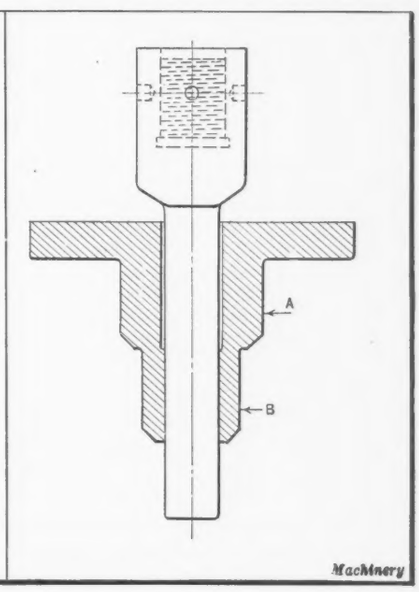


Fig. 7. Blank-holder and Punch used for Small Shells

of pressure would be required to straighten the flange out during the beading operation. To overcome this the final drawing die is made as shown at *H*, with a recess of the same diameter as dimension *B*. This gives a perpendicular flange at the end of the draw. Of course, in order to be able to use such a die, the punch for the preceding draw must be made straight at the bottom instead of beveled. The depth *J* should be made from 1/8 to 3/16 inch deeper than the radius at the bottom of the shell.

Drawing dies are made of the same material as the punches—semi-steel—and this also applies to the blank-holders that will be described later. The same care should be taken in allowing for finish on the die patterns as in the case of the drawing punches so that the hard outer shell will not be removed when the die is machined.

Construction of Knock-out

The construction of a knock-out is shown in Fig. 4. The face *L* is made to conform to the requirements of the job. The knock-out proper and the knock-out stem are made good sliding fits in the die. The thickness *G* of the knock-out should be about 2 inches. Length *M* of the stem should be great enough to permit the lower end to project at least an inch below the lower face of the die at the completion of the upward knock-out movement. Knock-outs are usually made of ordinary gray iron, as they are subjected to compression only. When the requirements of the job are such that the diameter of the stem is less than 1½ inches, it is well to make the stem of machine steel, as a cast-iron stem smaller than 1½ inches is likely to be broken.

Design of Blank-holders

A first-operation blank-holder is shown in Fig. 5. The diameter *A* is 1/32 inch larger than the punch diameter. Diameter *B* is made 1 inch larger than the blank, and diameter *C* is 4 inches larger than *B*. The total height and the thickness of the flange are arbitrary, but the figures shown have been found satisfactory for the average job.

The part shown in Fig. 6 is in reality a shell-holder, but it is more commonly called a blank-holder, so it will be referred to here by the latter name. This type is used for all drawing operations after the first one. Dimension *A* is 1/32 inch larger than the punch with which it is used, and *B* is 1/32 inch less than the diameter of the shell to be drawn. Dimension *C* is 4 inches larger than *B*, and *D* is 2½ inches higher than the shell it is to hold, while *E* is ordinarily made about 3/16 inch larger than *A*. This makes it possible to leave the cored hole of diameter *E* in the rough, and finish only about 3½ inches of the lower part.

The wall thickness *G* should not be less than 9/16 inch, but when the reduction is to be 1¼ inches or less, it is not possible to maintain the 3/16 inch difference between dimensions *A* and *E*. In such cases 1/64 inch might be all that could be allowed. When the reduction becomes still less, other methods of design must be resorted to. The angle *F* is made to suit the shell as it is produced in the preceding operation.

Holder for Small Shells

In Fig. 7 is shown the construction of a punch and blank-holder used for very small shells. The punch is made of cold-rolled steel or tool steel, depending on the quantity of shells to be drawn. The blank-holder can be made in two pieces; part *A* can be made of cast iron, and part *B* of machine steel or tool steel and forced into casting *A*.

It should be understood that all the external dimensions for dies or blank-holders here given need not be followed closely in most cases. While this article deals expressly with the design and construction of press drawing dies for round shells, the same principles apply to dies for square, rectangular, or oval work. The allowances for height are exactly the same as for round tools, and the thickness of the castings with relation to the holes is the same as in the case of round dies or blank-holders.

CASTING IN LONG-LIFE MOLDS

Foundrymen have always felt that the destruction of the mold every time a casting is poured is a decidedly inefficient procedure. It would be ideal if someone could develop a permanent-mold method of casting, and many attempts have been made in this direction. One scheme that has been used successfully for two years was described by Daniel Meloche at one of the Production Sessions in Detroit during the annual meeting of the Society of Automotive Engineers. Mr. Meloche pointed out that the following conditions would seem to require consideration in developing a mold of the "permanent" type: First, the mold surface must be of a highly refractory character, so that the least possible heat will be transmitted inward to affect the form of the mold as well as seriously limit the rate of pouring iron for castings into it. Again, a too hot mold will warp and deteriorate rapidly. Hence the desirability of having the mold light and, if necessary, air-cooled, so that the mold body temperature may be controlled. Second, the mold surfaces must be sufficiently strong to resist the cutting action of the molten metal and be impervious to the entrance of fine filaments of iron which, on removal of the casting, would take some of the mold material with it. Third, the mold surfaces must not chip off.

In the development described, the primary idea has been to make a very light cast-iron mold, the surface of which is covered with a layer of highly refractory material of the necessary thickness; this refractory material is protected from abrasion and penetration of fine iron filaments so that it rarely needs to be patched up or refaced. For operating purposes, where the castings are not large, a group of molds is placed upon a revolving table and the several steps of the cycle can be carried out almost automatically.

The refractory material forming the mold surface consists of two items, the refractory material itself and the binder to bind it to the iron backing. The molds are placed in their proper position on the revolving table and successively follow their prescribed course. In passing around, the two parts of the mold are drawn apart sufficiently to permit the settling of the cores, but just before this, each mold successively passes a flame which smokes the inner surfaces heavily. The idea of this is to interpose a film of carbon, or lampblack, between the refractory surface and the molten metal of sufficient thickness to prevent effectively any scoring action or the actual contact of metal and refractory material at the instant when the greatest temperature is reached.

After passing the flame and the position where the cores are set, the two parts of the mold are closed automatically and are held thus until poured off and the metal has set sufficiently. Then they quickly open and the castings are forced out by pins. Next, a blast of air rapidly blows the surfaces clean and the mold passes before the flame again. An attendant inspects the mold surface condition as the open molds pass by, and any fragment of iron or core left in the mold is easily removed with a suitable tool.

Since the iron backing of the mold is comparatively thin, air-cooling action can be effected. Sometimes an air blast is used to cool the iron molds a little faster than normally, and the machine can be speeded up and thus give a larger production. With 12 single molds on the revolving table, one man can pour 400 molds of a given kind per hour. With sand casting it takes eight times the number of man-hours to get an equal number of the same kind of castings.

* * *

The record of industrial accidents for the year 1922, compiled by the Bureau of Labor Statistics, shows that the total number of accidents amounted to 1,307,073, and with the exception of New York, for which separate figures were not obtainable, there were 7947 fatalities reported. These figures do not constitute a complete record of the number of accidents in the country, but show those that come within the Workmen's Compensation Acts of the different states.

Grouping Machines Economically

Investigation of the Principles Controlling Efficient Grouping of Machines and Operations

By HOWARD M. GROFF, Treasurer, Buch-Groff Co., Trenton, N. J.

TWO factors encountered frequently in modern production methods are the determination of efficient and economical grouping of operations and machines when more than one machine is under the care of one operator, and the determination of a practical method of calculating manufacturing costs on such operations. Having solved these two phases of the problem, the setting of piece-work rates or tasks, where the task-and-bonus system is employed, is simplified considerably. No longer is the element of guesswork included. In this article some of the laws that govern the economical grouping of machines to be run by one operator will be considered and a practical method of setting tasks on such operations will be described. The method can be applied to groups of shapers, planers, engine lathes, power milling and drilling machines, etc. Batteries of roll-feed power presses have also been arranged according to this method.

These problems are studied by plotting the hand and machine time on cross-section paper, as shown in Fig. 1. The time is laid off from the left to the right on the horizontal lines and each small division on the cross-section paper represents one minute. In the illustration the small divisions are not shown, each unit of time in the diagram representing eight minutes. The heavy lines denote hand time, and the dotted lines, machine time. The same results may be achieved by the use of a plotting board such as shown in Fig. 2. This board is grooved to receive sliding blocks of wood that are colored with red triangles to denote hand time and black triangles to represent machine time. The distance between two successive vertical edges of these triangles represents hand or machine time as the case may be. The scales are made by cutting cross-section paper into strips and gluing them on the face of the board.

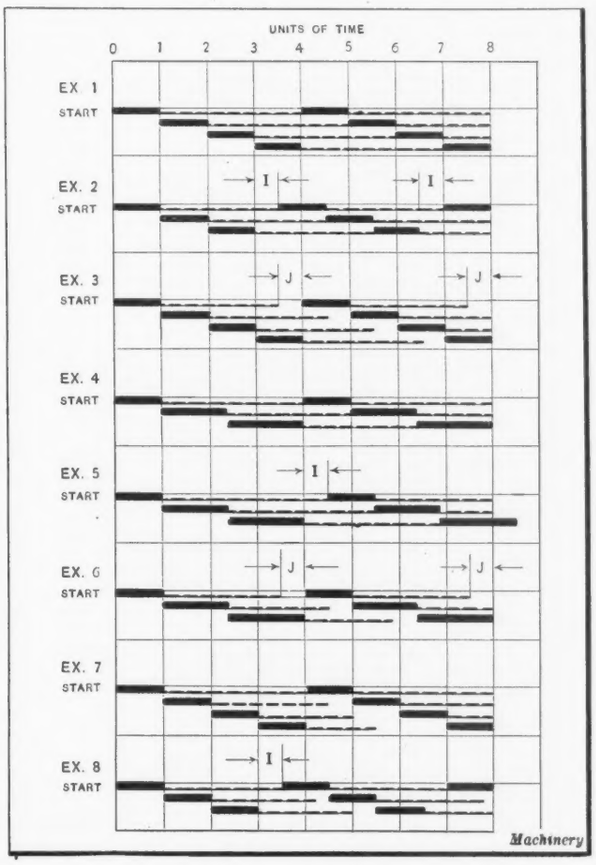


Fig. 1. Method of plotting the Hand and Machine Time on a Group of Machines run by One Operator

Definitions and Symbols

The following terms will be used in this article and symbolized in the various formulas:

Hand Time (H)—The time required to unload and load a fixture, start the machine, and walk and turn to the next machine.

Machine Time (M)—The time required for one machine to perform the operation.

Total Time—The hand time plus the machine time.

Idle Man Time (I)—The time during machine time, that is not hand time on any machine of the group.

Idle Machine Time (J)—The time during which a machine is not running due to hand time occurring simultaneously on another machine. (Note: Idle man time *I* is always given per group, and idle machine time *J*, per machine).

Interference—Either idle man time or idle machine time or both.

Cycle—The operator, necessarily, has a certain routine for handling the machines in his group. This routine repeats itself, and the length of the cycle is the time between any two similar points in two succeeding repetitions. The cycle is often, but not always, equal to the longest total time.

Other symbols used in the article are as follows:

N = number of machines a man can handle without idle machine time;

n = number of machines a man can handle without idle man time;

W = wage cost per piece;

w = hourly wage of operator; and

P = production per hour per man $= \frac{w}{W}$.

Classification of Machine Groups

Any group of power milling or similar operations falls or can be made to fall in one of the following four classes:

Class A—Groups in which the total time of all operations is equal, and in which the hand time and machine time are in the same proportion in each operation.

Class B—Groups in which the total time of all operations is equal, and in which the hand time and machine time are *not* in the same proportion in each operation.

Class C—Groups in which the total time in each operation is unequal, but in which the hand time in each is equal.

Class D—Groups in which the total time in each operation is unequal and in which the hand time in each operation is also unequal.

Groups in Class A

Class A will include groups such as those in which each machine is doing the same operation on a similar part and in which the tools are duplicates. This class can be subdivided into two main cases:

Case 1—Operations in which the machine time is an even multiple of the hand time.

Case 2—Operations in which the machine time is *not* an even multiple of the hand time.

For Case 1, $N = n = \frac{M}{H} + 1$, and there will be no interference. Example 1 in Fig. 1 illustrates this case. Also $W = \frac{wH}{60}$. (This is the case only when $N = n = \frac{M}{H} + 1$.) It can be perceived that the number of machines in a group in this case does not affect the wage cost. Also note that M does not appear in the formula for W.

As an illustration of Case 1, let $H = 8$ minutes, $M = 24$ minutes, and $w = 45$ cents per hour (as represented in Example 1, Fig. 1). Then

$$N = n = \frac{24}{8} + 1 = 4 \text{ machines} \qquad W = \frac{45 \times 8}{60} = 6 \text{ cents}$$

and

$$P = \frac{45}{6} = 7\tfrac{1}{2} \text{ pieces}$$

With operations in which the machine time is not an even multiple of the hand time (Case 2) idle hand time and idle machine time must be considered. Now $N = \frac{M}{H} + 1$. Numerically this will result in a mixed number, and obviously the fraction must be dropped and the integer taken as N.

Then

$$I = M - (N - 1)\ H = M + H - NH$$

The wage cost per piece if there is no idle machine time is found from the following formula:

$$W = \frac{w(NH + 1)}{60N} = \frac{w(M + H)}{60N}$$

Therefore when $N = \frac{M}{H} + 1$, the machine time affects the cost and there is an opportunity to reduce the wage cost by changing the feed of the machines, causing the group to approach Case 1 as a limit.

Now as represented by Example 2, Fig. 1, let $H = 8$ minutes, $M = 20$ minutes, and $w = 45$ cents.

Then

$$N = \frac{20}{8} + 1 = 3.5 \text{ or, dropping the fraction, 3 machines}$$

and

$$I = 20 + 8 - (3 \times 8) = 4 \text{ minutes}$$

$$W = \frac{45\ (20 + 8)}{60 \times 3} = 7 \text{ cents}$$

$$P = \frac{45}{7} = 6\ 3/7 \text{ pieces}$$

If the feed of the machines was increased 20 per cent, the group in Example 2, would come in the Case 1 group with 3 machines, and if the feed were decreased 20 per cent the group would come in the Case 1 group with 4 machines.

If there is no idle man time in a group of machines in Case 2, there is idle machine time; then

$$n = \frac{M}{H} + 2 \text{ and } J = nH - H - M$$

[Note: Any integer greater than 1 may be used for n but only to increase the number of machines without increasing production or changing costs.]

$$W = \frac{wH}{60} \text{ only when } n = \frac{M}{H} + 2$$

As illustrated by Example 3, Fig. 1, using the same values for H, M, and w as were used in Example 2,

$$N = \frac{20}{8} + 2 = 4.5 \text{ or, dropping the fraction, 4 machines}$$

$$J = (4 \times 8) - 8 - 20 = 4 \text{ minutes}$$

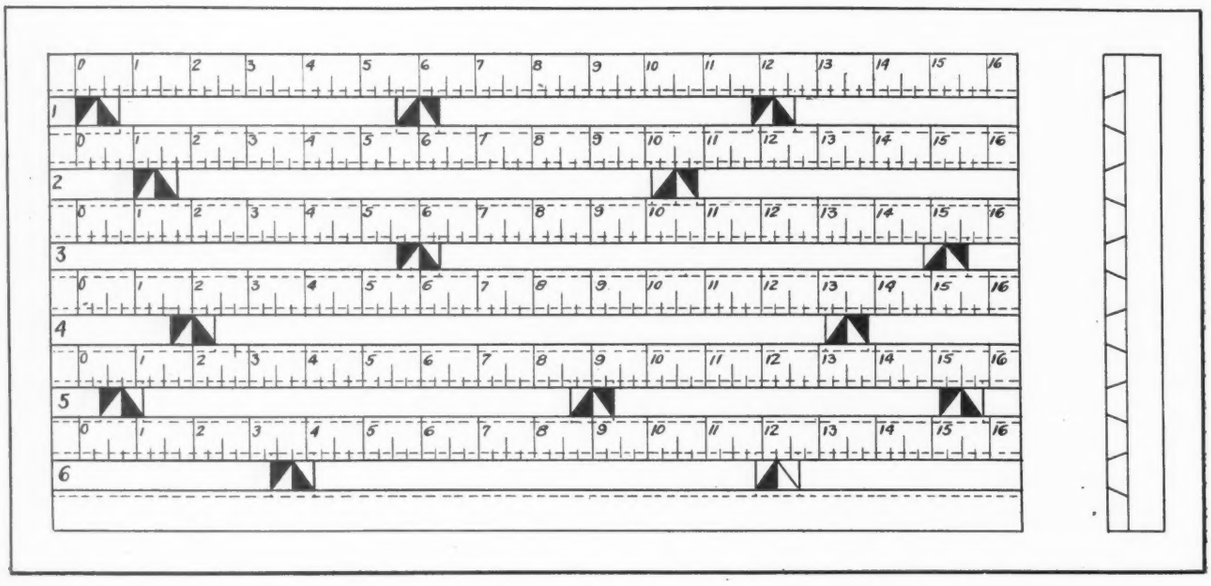


Fig. 2. Plotting Board with Wood Blocks which may be used instead of Cross-section Paper for plotting

$$W = \frac{45 \times 8}{60} = 6 \text{ cents}$$

$$P = \frac{45}{6} = 7\tfrac{1}{2} \text{ pieces}$$

Machine Groups Under Class B

A group of machines in Class B is a rarity, unless the machine times are adjusted by changing the feeds, with the view of making the group fall into this class.

Let M_1 = longest machine time, M_2 second longest, M_3 shortest, etc.; and H_1 = hand time of machine with the longest machine time, H_2 with second longest, H_3 with shortest, etc. Then if $M_1 = H_2 + H_3 + \ldots H_n$, $I = J = 0$.

This is illustrated by Example 4, Fig. 1, and indicates that changing the feeds of machines to make the longest machine time equal the sum of the hand time on all other machines, will give the maximum production. But if the machine time of one machine is changed, the machine time of all the others must be changed a like amount; otherwise the group will not fall into this class. In this case,

$$W = \frac{w}{60N} \times (H_1 + H_2 + H_3 + \ldots H_n)$$

For example, let H_1, H_2 and H_3 equal 8, 11, and 13 min-

utes, respectively; M_1, M_2, and M_3, 24, 21, and 19 minutes, respectively; and w, 45 cents.

Then,

$$M_1 = 11 + 13 = 24$$

and

$$W = \frac{0.45\ (8 + 11 + 13)}{60 \times 3} = 8 \text{ cents per piece}$$

$$P = \frac{45}{8} = 5\ 5/8 \text{ pieces per hour}$$

If M_1 is greater than $H_2 + H_3 + \ldots H_8$, then $J = 0$.

But

$$I = M_1 - (H_2 + H_3 + \ldots H_8)$$

and

$$W = \frac{w}{60N} \times (H_1 + H_2 + H_3 + \ldots H_8 + 1)$$

$$W = \frac{w}{60N} \times (H_1 + H_2 + H_3 + \ldots H_8 + M_1 - H_2 - H_3 - H_8)$$

$$W = \frac{w\ (H_1 + M_1)}{60N}$$

As illustrated by Example 5, Fig. 1, let $H_1 = 8$ minutes; $H_2 = 11$ minutes; $H_3 = 13$ minutes; $M_1 = 28$ minutes; $M_2 = 25$ minutes; $M_3 = 23$ minutes; and $w = 45$ cents per hour. Since M_1 is less than $H_2 + H_3$, $J = 0$. But

$$I = 28 - (11 + 13) = 4 \text{ minutes}$$

and

$$W = \frac{45\ (8 + 28)}{60 \times 3} = 9 \text{ cents per piece}$$

$$P = \frac{45}{9} = 5 \text{ pieces per hour}$$

If M_1 is less than $H_2 + H_3 + \ldots H_8$ as represented by Example 6, then $I = 0$.

But

$$J = H_2 + H_3 + \ldots H_8 - M_1$$

and

$$W = \frac{w}{60N} \times (H_1 + H_2 + \ldots H_8)$$

Let $H_1 = 8$ minutes; $H_2 = 11$ minutes; $H_3 = 13$ minutes; $M_1 = 20$ minutes; $M_2 = 17$ minutes; $M_3 = 15$ minutes; and $w = 45$ cents. Since M_1 in this case is less than $H_2 + H_3$, $I = 0$.

But

$$J = 11 + 13 - 20 = 4 \text{ minutes}$$

and

$$W = \frac{45\ (8 + 11 + 13)}{60 \times 3} = 8 \text{ cents}$$

$$P = \frac{45}{8} = 5\ 5/8 \text{ pieces per hour}$$

Cases Under Class C

Class C would include groups such as those in which each machine is performing a different cut on the same or similar pieces. If M_1 is an even multiple of H, as represented by Example 7, then $n = \frac{M_1}{H} + 1$. No expression can be found for N because J will never equal zero. With n equal to the expression given, $W = \frac{wH}{60}$. For example, let $H = 8$ minutes and $M_1 = 24$ minutes; $M_2 = 20$ minutes; $M_3 = 16$ minutes; $M_4 = 12$ minutes; and $w = 45$ cents. Since M_1 is an even multiple of H, $\left(\frac{24}{8} = 3\right)$, then

$$n = \frac{24}{8} + 1 = 4 \text{ machines}$$

$$W = \frac{45 \times 8}{60} = 6 \text{ cents}$$

and

$$P = \frac{45}{6} = 7\tfrac{1}{2} \text{ pieces per hour}$$

If M_1 is not an even multiple of H, let X equal the integral number found by dividing M_1 by H and dropping the fraction. The existence of a fraction indicates that idle man time will occur. However, if M_1 is greater than H there will be no idle machine time on the first machine and

$$N = X + 1 \text{ and } W = w \times \frac{(H + M_1)}{60N}$$

Now, as represented by Example 8, let $H = 8$ minutes; $M_1 = 20$ minutes; $M_2 = 18$ minutes; $M_3 = 16$ minutes; and $w = 45$ cents. M_1 is not an even multiple of H since $\frac{20}{8} = 2\tfrac{1}{2}$; dropping the fraction, $X = 2$, and as M_1 is greater than H,

$$N = X + 1 \text{ or } 3 \text{ machines}$$

$$W = \frac{45\ (8 + 20)}{60 \times 3} = 7 \text{ cents per piece}$$

and

$$P = \frac{45}{7} = 6\ 3/7 \text{ pieces per hour}$$

Here again there is an opportunity to reduce the wage cost per piece by increasing the feed of the machine, thus reducing the longest machine time until it approaches an even multiple of the hand time. If M_1 is less than H, the idle machine time even when $n = 2$, will generally be prohibitive.

Class D Groups

No laws have been found to apply to groups of machines in Class D, and so each case must be studied by itself. As a rule the results of running groups of this class will not be economical; nevertheless the class is a large one in many plants. The hand time and machine time should be laid out graphically or on a "grouping board" to determine the number of machines necessary to keep the operator always busy. If there must be a Class D group that does not keep the operator busy all the time, then the idle man time should be determined from the board, and if it is task work, should be added to the time allowed for the day's work. In groups of this class, care should be taken to see that the hand time of any operation is not longer than the machine time of any other.

Determining the Hand and Machine Time

If, for instance, when designing tools for milling a new part, there is but one power milling cut to be taken, the hand time and the machine time should be calculated by that division of the engineering department controlling the planning and time-study work. The hand time can be determined with a fair degree of accuracy from the designer's lay-out of the fixture and from detail records of the hand time on jobs already established. The machine time can be found from data on power milling speeds and feeds and machine specifications. If the machine time is greater than the hand time, it would be well to build more than one fixture so as to make the group fall in Class A or Class B. In such cases production and the cost of fixtures, etc., should naturally be taken into consideration.

When instances occur where there are several cuts in sequence on the same piece, they should be combined into one or more tasks, according to economical grouping. Often it will be found profitable to combine bench work, hand milling, drilling, etc., with power milling operations, for instance, but only in cases where the production would be too great if only power milling were done by the group.

Grouping by Percentage of Hand Time

The grouping of machines on task work in accordance with the percentage of hand time to the total time of each operation is purely an arbitrary method, and bears little or no relation to the actual determining factors. The method is this: Suppose there are five jobs with an independent task on each one, that is, a task which has been set as if the job were to run alone. Let us call the machines for the various jobs *A*, *B*, *C*, etc. In each one the hand time is divided by the total time and the result multiplied by 100 to find the percentage of the hand time to the total time. Assume, for instance, that the hand time of *A* is 10 per cent; *B*, 20 per cent; *C*, 30 per cent; *D*, 30 per cent; *E*, 40 per cent; and *F*, 30 per cent. From these jobs should be selected those whose percentages do not total more than some arbitrary figure, say 60 per cent. Then we may run together *A*, *B* and *C*; *C* and *D*; *B* and *E*, etc.

As a matter of fact, almost any other combination may be run, depending on the class in which they lie. For instance, machines *C*, *D*, and *F*, with a total of 90 per cent will run without interference if they are in Class A; machines *B* and *C* will not run without idle machine time if the hand time of *C* is greater than the machine time of *B*, yet they only total 50 per cent. This total percentage is not always the percentage of the man's time that is occupied except in Class A, and in this class the most economical operation is possible by filling up the man's time or giving him 100 per cent.

Allowance for Rest and Delays

One reason for the arbitrary total of 60 per cent instead of 50 or 90 per cent is the fact that the allowance for rest and delays used in calculating the tasks usually is so small that the operator cannot earn the bonus when his time is nearly or completely occupied. Nor can this be expected, for the group approaches, so far as he is concerned, a hand operation. Consider job *B* and allow 25 per cent of the hand time and 10 per cent of the machine time for rest and delays. Then

25 per cent of 20 per cent = 5 per cent
10 per cent of 80 per cent = 8 per cent
Total allowance on operation = 13 per cent

It can now be seen that if the operator's time is entirely or almost entirely occupied with jobs similar to this, he is required to perform practically a hand operation with only from 10 to 15 per cent leeway. In a hand operation, we allow, say, 25 per cent for rest and delays, which is equivalent to allowing the operator 15 minutes each hour. This is so, provided he works at the requisite speed during the remaining 45 minutes.

If a man is running a group of machines which takes his entire time, his allowance should be 25 per cent; if there is a little idle man time per cycle, his allowance should be a little less than 25 per cent; but if he is running one machine with a machine time of 5 minutes, the allowance should be considerably less than 25 per cent. We will therefore assume that at least one idle-man time per hour may be used for rest and reduce the 15 minutes by this amount. Dividing the difference by 45 will give a new percentage which is fair if 25 per cent is fair. The rule in force at one plant has been to subtract the machine time from 15 and divide by 45. For a task covering a group, the words "idle man-time" should be substituted for "machine time." The basis of 20 per cent should be considered and the decision left to the judgment of the task setter. This rule may be symbolized as allowance for rest, etc., as follows:

$$\frac{15 - I}{45} \quad \text{or} \quad \frac{10 - I}{50}$$

Temporary Groupings

Operations that cannot be grouped permanently and on which there is a task covering the group, should not have a task set on them separately. If bonus operations of this kind are run together, they will invariably form a group of Class D, where either the production, the number of machines, the leeway for rest and delays, or all of these are right only by chance; and even then one job will be completed before the rest and leave too few machines, or be substituted by a misfit.

The method proposed is this: The Engineering Department should keep on file for each of these jobs a record of the necessary hand time, the machine on which the operation will be done, and the highest practical machine feed. When the lay-out clerk desires to run certain jobs together, he should send the part numbers to the Engineering Department, which will then set a task for that combination. With the information at hand and the grouping board, only a few minutes' time is required to set the task. The wage cost will be different each time, perhaps, but it usually is different under the methods employed by many.

As far as possible, the orders for parts necessarily in Group D should be fixed the same, so that the operations on all machines of this group will be completed at the same time. This will avoid loss of operators' time due to an insufficient number of machines, or the necessity of finding another job to take the place of one run out, and to retain the same production on the ones still running.

* * *

MAKING EVENLY SPACED GUIDE LINES FOR LETTERING

By ARTHUR PONELEIT

Uneven lettering is detrimental to the appearance of a tracing or drawing, and for this reason most draftsmen use guide lines when lettering a tracing that is required to present a neat appearance. The writer has found that a rapid and convenient means of spacing the guide lines is provided by a 30-degree triangle with a series of properly spaced holes drilled through it. These holes are countersunk to a depth of one-third or one-half the thickness of the triangle and are just large enough to permit the end of a sharp pencil to project through the triangle. The spacing holes may be laid out on parallel lines that are at right angles with the base of the triangle or on lines that are inclined at an angle with the base.

In drawing guide lines, one side of the triangle is placed in contact with the edge of the T-square blade. The latter is moved up or down until the spacing holes selected are properly located on the drawing. The pencil point is then inserted in one of the holes and the triangle and pencil drawn from left to right the distance required to produce a line of the desired length. The pencil is then removed and inserted in the proper hole for spacing the second line, which is drawn in the same manner as the first.

* * *

Bills to introduce the metric system by compulsory legislation are objectionable enough, but what is to be said of such a bill as has recently been introduced in Congress providing that the standard foot be divided decimally into 10 digits, 100 lines, and 1000 points? A new ounce is also created, which is the weight of a cube of water the side of which is 0.1 foot. This ounce is also divided decimally. A new pint is created, equal to the volume of one pound of water at its maximum density; there does not appear, however, to be any statement in the bill as to what the standard pound will be in the future. Furthermore, while the bill disposes entirely of the inch as a measure of length, it nevertheless contains a section in which it states that the conversion of inches into millimeters shall be by the factor 25.4 as a multiplier. The saving grace of the bill is that "this act shall not be construed to prohibit the use of any measure not defined herein." In other words, if the bill were passed, our system of weights and measures would remain much the same as in the past, because it is hardly conceivable that anybody would want to make use of the proposed system.

Notes and Comment on Engineering Topics

The Gage Steel Committee of the Bureau of Standards has issued its eighth progress report on gage steel investigation, dealing with length changes due to hardening, and hardness tests on deep-hardening steels. A complete copy of this progress report may be obtained from H. W. Bearce, Secretary, Gage Steel Committee, Bureau of Standards, Washington, D. C.

A power plant has been put into operation in Switzerland which operates under a head of over 5000 feet, producing 12,000 horsepower. The water is conducted to the power plant by a single pen stock less than 2 feet in diameter. The water utilized in this development is drawn from a small lake located in the Alps at an altitude of about 7000 feet above sea level. The pen stock has a total length of about 3 miles and is made up of a series of steel pipes of different thicknesses according to the head of water. The power plant consists of four units of 3000 horsepower each, the water issuing at the nozzles into the turbines at a velocity of about 540 feet per second.

No country in the world has as highly developed a system of modern transportation as the United States, and still the industrial development of the country is moving forward at a more rapid rate than the transportation facilities. In the last ten years, the number of freight cars has increased by 23 per cent and the aggregate tractive power of locomotives by 41 per cent, but the country is offering the railroads 60 per cent more traffic to haul. At present there are in the United States 259,000 miles of railroad, 18,000 miles of interurban electric lines, and 350,000 miles of improved highways. Altogether, it is estimated that there are 2,800,000 miles of roads in the United States, of which, however, only 12.5 per cent is properly improved for automobile traffic.

The construction of some very large electrical generating units is reported in the annual review of engineering achievements of the Westinghouse Electric & Mfg. Co. for 1923. Among other large machines are mentioned a 62,500-KVA steam-turbine generator, said to be the largest single unit of this type in the world. A 43,750-KVA machine making 1800 revolutions per minute is also under construction, and is stated to be the largest steam-turbine generator of this speed ever built. In the entire electrical field, the tendency is to employ larger units in order to gain increased efficiency and reduce operating costs. In the electrical furnace field, for example, the past year has witnessed the installation of the world's largest arc furnace, having a maximum capacity of 60 tons.

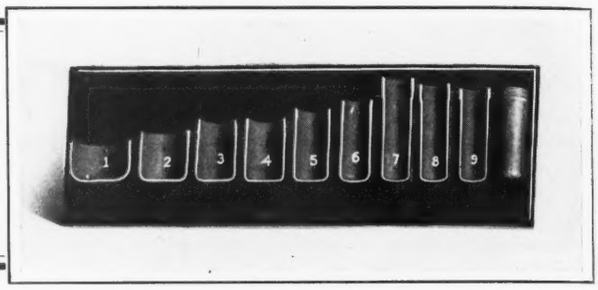
Some time ago it was mentioned in American trade journals that a rustproof iron had been developed in Sweden. It has now been announced that this iron is being manufactured on a commercial scale by Aktiebolaget Ferrolegeringar, Trollhättan, Sweden. This company has succeeded in finding a method of producing rust-free iron and mild steel at a cost that will make this material available for many ordinary uses. It is stated that this iron is impervious to the action of most acids. The new metal or alloy has a fine silver-gray color and can be rolled into any of the usual sections. In composition, it is a chrome-alloy iron, and while its cost is greater than that of ordinary iron or mild steel, it is estimated that if used for roof covering, the plate would not cost more than 50 per cent in excess of galvanized plate. Its lasting qualities would far outweigh the additional first cost.

A striking example of the efficiency of national standardization as it has been developed in Germany is found in the methods by which a rush order placed with German manufacturers for 200 locomotives to be built for Russia, was handled. Dr. P. G. Agnew, secretary of the American Engineering Standards Committee, who has recently visited Germany in the interests of American standardization work, states that the production of different parts was allotted to seventeen different manufacturers to be produced strictly on the plan of interchangeable parts, no one manufacturer making a complete locomotive. No serious practical difficulty was encountered in filling the order. The inspectors made a particularly striking test of the feasibility of the plan by ordering a complete locomotive to be assembled from parts chosen at random from the parts furnished by the seventeen manufacturers. It is said that it proved to be ready for service immediately after assembly, without the necessity of any disassembling for readjustment.

In experiments made with steam and hot water radiators, coated with aluminum paint, it has been found that only about 80 per cent as much heat is conveyed into the room to be heated as when the radiators are coated with zinc oxide paint, green or white enamel, or terra cotta shellac varnish. In general, a gain of from 15 to 20 per cent in heat dissipation into a room may be expected by covering the ordinary radiator with non-metallic paint instead of with an aluminum or bronze paint. By non-metallic paint is meant a covering that does not contain flakes of pure metal, such as aluminum or bronze. If the radiator is already coated with aluminum paint, the required effect may be obtained by painting the non-metallic coating over the aluminum paint. The trouble with aluminum paint lies apparently not in the fact that it is not a good conductor of heat but that it is a poor radiator of heat. The non-metallic coating need not be a black paint. The white lead and zinc oxide paints and enamels, the chrome-colored pigments, and the greenish colored oxides, such as chromium oxide, offer a variety of tints for decorative purposes, with greater efficiency in heat dissipation.

In a paper presented before the February meeting of the American Institute of Mining and Metallurgical Engineers in New York, dealing with the effect of severe cold-working on scratch and Brinell hardness of metals, several interesting conclusions were presented. Cold-working is generally considered a process of hardening metals. Diametrically opposite statements concerning the applicability of the scratch-hardness method in the testing of cold-worked metals, particularly after severe deformation, found in technical literature, led to the study of the results summarized in this paper. A series of metals, among which were copper, iron, and tin, were cold-rolled to a definite degree without any intermediate annealing, and the hardness determined by both the scratch and Brinell methods. The results indicated that the metal hardens rapidly during the initial stage of deformation; however, after a certain stage, which corresponds to a rather definite microstructure, the metal becomes softer, and in its final form may be softer than the metal in its initial stage. The softening of the metal after a certain stage is ascribed to the fact that the previously existing crystalline condition of the metal is destroyed, and then appreciable softening occurs.

Unusual Metal Drawing



RESULTS that seem almost impossible of accomplishment are feasible in sheet-metal drawing. The metal can be made to take unusual shapes and to respond readily to applied pressures if the proper kind of metal is used and careful attention given to the design of the drawing dies. Two collections of unusual shells that have been sawed open to show the sectional shape after each operation, are presented in the heading illustration and in Fig. 1. The tools used in drawing these shells were designed by H. G. Carlson, superintendent of the Rockwood Sprinkler Co., Worcester, Mass. They embody principles that may be applied generally in sheet-metal drawing.

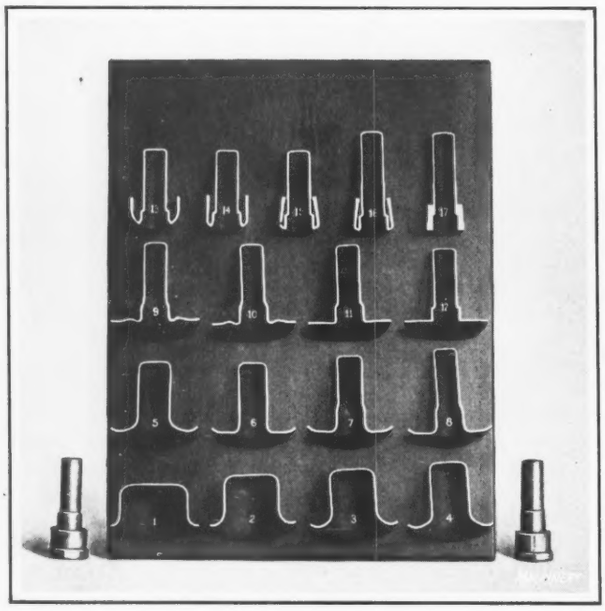


Fig. 1. Flanged Shell with Straight Interior and Tapered Exterior

These shells have a straight hole and a tapered exterior, the metal being comparatively thin at the closed end and thickening toward the open end. They are made from open-hearth, hot-rolled dead-soft steel, and the sheets are well oiled. The steel contains from 0.08 to 0.12 per cent carbon; less than 0.05 per cent sulphur; less than 0.045 per cent phosphorus; and from 0.30 to 0.50 per cent manganese.

Reference to the set of shells in the heading illustration will show that after the first four drawing operations the shells are straight on both the interior and exterior, but from then on the thinning of the stock at the closed end and the tapering commences. A sectional view of the punch and die used in the seventh operation is shown in Fig. 2. This design is typical of all others used in this plant for producing a straight hole and a tapered outside surface. Any long-stroke single-action press is suitable for the job.

The die *A*, which is held in the die-block by a ring, is designed with liberal drawing radii on the central hole, and machined out underneath to receive a drawing ring *B*. The design of this drawing ring, in combination with the rounded punch which has a reverse taper at *C*, makes it possible to produce a tapered shell with a straight hole. The metal is drawn over the annular ring *D*, formed on the inside of the drawing ring *B*. To facilitate the drawing of the metal, the pressure is applied at only one point between the punch and the die ring.

As the punch draws the shell, the radial pressure on the metal decreases in proportion to the decrease in the diameter of the punch, so that the metal is thicker around the reduced diameter of the punch. During the upward stroke of the press ram this thicker metal is expanded by the punch, practically filling the hole in die *A*. The exaggerated sketch at the right shows, in section, the shape of the shell before the punch starts to ascend. At this point the overhead stripper plate has brought the bushing *E* into contact with the end of the shell, so that on the upward stroke of the ram the shell is stripped from the punch.

Before being stripped, the shell is securely held on the punch by its reverse inside taper, as the sketch shows, but in stripping, the large end of the punch expands the metal as it is withdrawn, thereby transferring the inside taper to the outside and reversing it, leaving a straight cylindrical hole. In the enlarged sketch, the punch and shell are shown by the dotted outline as this expansion is completed. The liberally curved drawing edges on these tools, the venting of the punch, and the generous lubrication of the metal are all contributary factors in producing a smooth shell of uniformly tapering section.

In the final operation, the shell is upset at the open end, which is later squared and threaded. The power press

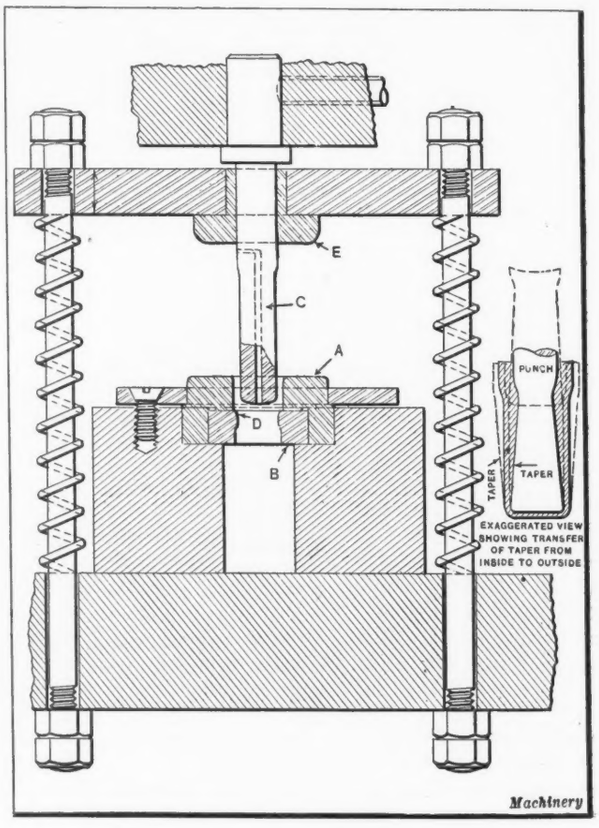


Fig. 2. Drawing Die for producing Shell with a Straight Hole and a Tapered Exterior

equipment employed for upsetting is illustrated in Fig. 3. A heavy coil spring *D*, made of 7/8-inch wire, is used in the slide to convert the long-stroke single-action press on which the equipment is used so that a second action is obtained to permit the shell to be held in the die by the punch after drawing, while the end is being upset.

As the ram descends, the punch enters the shell, drawing it from 0.915 to 0.905 inch inside diameter, as shown by the enlarged sections. During the drawing operation the heavy spring is not appreciably compressed, but from the time that the punch bottoms in the shell until the end of the stroke is reached, the spring acts as a buffer, permitting the punch to remain stationary while the upsetting is being performed. The upsetting is done by sleeve *E*, which is brought against the shell when the stripper plate *C* is depressed. In forming the head, the metal at the 0.930-inch inside diameter is forced in around the punch. The result is a straight hole throughout the length of the shell. Die-ring *F* is designed with a sharp shoulder at the upset end, but there is very little flow of metal outward at this point to wear it away.

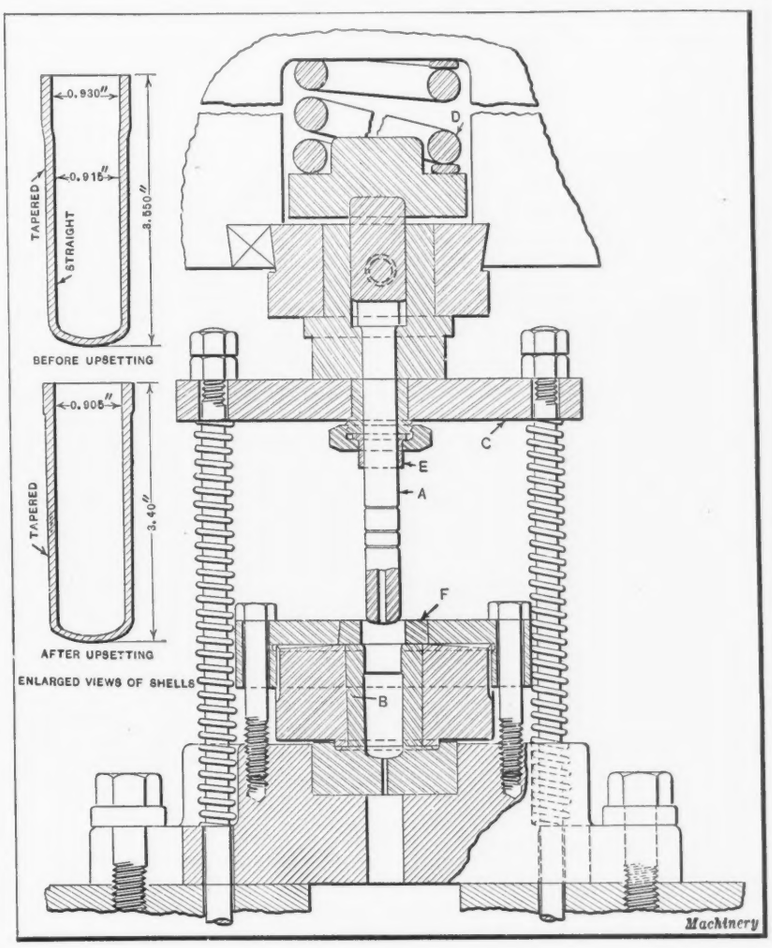


Fig. 3. Cross-section View of Upsetting Die, showing its Special Application to the Power Press

Air vents are provided at the bottom of the die and through the punch, and relief grooves are ground on the punch. The thickness of the metal at the thinnest portion, which is at the rounded end, is 0.04 inch, and at the thickest portion, directly beneath the head, 0.058 inch. The upset end is 1.16 inches in diameter.

In drawing up the shell illustrated in Fig. 1, a large-diameter flange is formed, which, in a series of press operations, is folded back against the side of the shell and finally upset with a hexagonal head, so that the flange becomes curled in and compressed against a shoulder on the outside of the shell.

* * *

SELF-CONTAINED ELECTRIC POWER PLANT

A self-contained electric light and power plant for small installations has been brought out by the Westinghouse Electric & Mfg. Co., for services where central station current is not available. This small self-contained plant consists of a gasoline engine, an electric generator, and an electric starter and control, all built into a single compact unit. It also includes a storage battery in which to store the electrical energy from the generator. The engine is air-cooled, so it is possible to install it in an unheated building. It will operate either on gasoline, kerosene or natural gas, and will bring electric light and power conveniently to farms, small country hotels and inns, and summer homes.

ADVANTAGES OF THE TURBINE DRIVE

Although vessels were propelled by electricity as early as 1893, the first important installation of this drive was on the collier *Jupiter* in 1913. Two other colliers were constructed at the same time, one equipped with geared turbines and the other with reciprocating engines. The testing of these three methods of propulsion demonstrated that geared turbines were desirable in the vessels below the capital class, but that electric drive was superior for vessels of the capital class. The most important advantage of the electric drive for battleships is the fact that the steam part of the propelling machinery is not connected with the propellers by means of shafting. The turbine generators and auxiliaries can therefore be placed in absolutely watertight compartments, where they receive the maximum amount of protection, while the propeller motors can be so placed that the propeller shafts penetrate the smallest number of bulkheads, reducing to a minimum the danger of flooding in case a ship is struck by torpedoes or shells. There are other advantages of the electric drive as compared with the steam drive: The piping can be given better protection; the propeller shafts, being shorter, are more reliable; either turbine generator can be used alone for ordinary cruising speeds permitting repairs on the other one; excellent economy of operation can be obtained, especially at cruising speeds; and finally, full power, instead of only about half power, can be applied for reversing the propellers, providing a high degree of manoeuvering power.

* * *

CHINESE INVENTIONS AND DISCOVERIES

A number of the important discoveries and inventions that were made in China long before they were known to the Western world are mentioned in *Research Narratives*, published by the Engineering Foundation. Records show that the compass was known in China in 1100 B.C.; printing from stereotyped wooden plates goes back to 593 A.D.; glass was manufactured in the early part of the second century; and paper was made in the early part of the first century. An instrument that would record slight earthquake shocks not perceptible to human senses was invented in the first century, and metallic coins were in circulation nearly 3000 years B.C. Unfortunately the Chinese mind, through centuries of classical education that ignored all initiative, has failed to progress along the same lines as the ancient Chinese.

Accuracy in Machining Shouldered Work

By ALBERT A. DOWD

THE majority of work is so designed that small variations in shoulder distances are permissible. Slight variations in the depths to which holes are counterbored are also allowable in most cases. Occasionally, however, a shoulder must be located very accurately, or a counterbored depth must be machined within close limits. Work of this kind is often done on the turret lathe as shown in Fig. 1, in which the work *A* is counterbored at *B*. In this particular case, the depth of the counterbored portion is of extreme importance. The longitudinal stops on a turret lathe are sufficiently accurate for normal work, but for extreme cases, like the example shown, it is not an easy matter to hold the work within the required limits without employing special equipment. However, with a small amount of labor and the help of a simple contrivance, the required accuracy can be obtained.

The turret-slide is drilled and tapped to receive the stud *K*, which is provided with a check-nut *L* to preserve the adjustment when once set. The bracket *G* is fitted to the longitudinal ways of the lathe, and has a strap *H* by means of which it can be locked in any desired position. A standard form of dial indicator *F* is mounted on the bracket as shown. In machining the work *A*, the counterbore at *B* is first machined to within about 1/32 inch of the depth required, at which position the longitudinal turret stop is set up lightly. The tool *D* in holder *E* is next fed into the work carefully until the required depth is almost reached. At this point the longitudinal stop is locked firmly. Then by using considerable pressure on the hand-feed wheel, the depth is accurately obtained and the indicator dial turned to read zero. Any number of pieces can now be machined accurately to depth by the same process of first coming up to the longitudinal stop and then using pressure to force the tool in until a zero reading is obtained. This method has some disadvantages, however, as it interferes with the free use of the cross-slide. Also any other tools used in the same machining operation must be made long enough so that the turret-slide will not come up too far and disturb the indicator setting. Obviously, the designer of tools should look into such matters before starting the actual design.

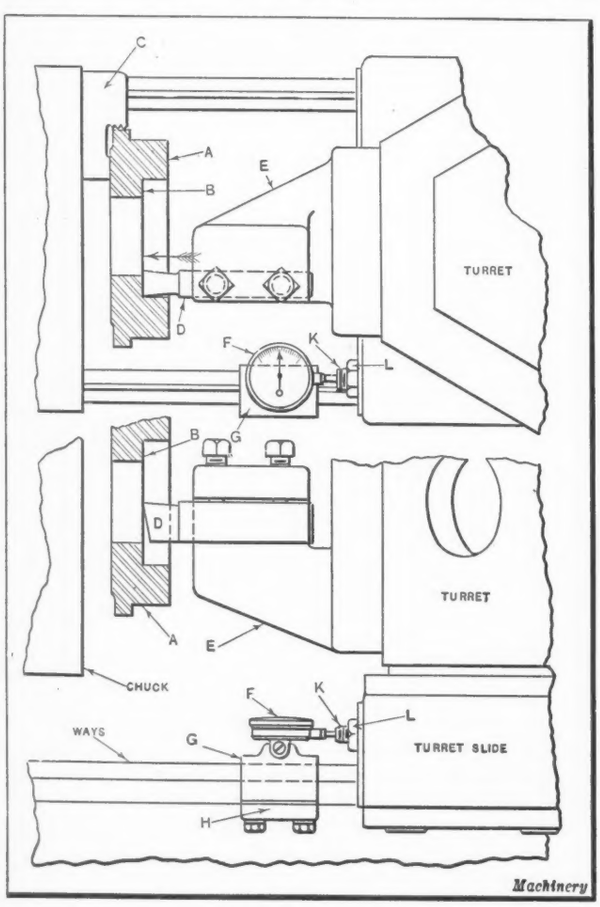


Fig. 1. Method of obtaining Accurate Shoulder Distances with Turret Lathe

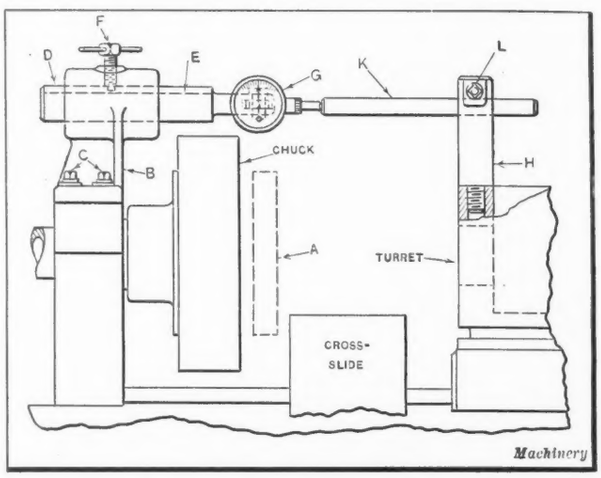


Fig. 2. Attachment used for Accurate Facing Operation, which permits Use of Cross-slide

Another arrangement which is more flexible and can be adapted to a greater variety of conditions is shown in Fig. 2. This attachment has a number of advantages over the preceding example, as there is no possibility of interference with the cross-slide or with any of the other turret tools. In this case let it be assumed that the work *A* is similar to that shown in Fig. 1, and that it is held in the ordinary way in chuck jaws. The cross-slide can be locked in position for facing, and the depth of recess maintained by using the attachment shown, in connection with various turret and cross-slide tools, as required.

The bracket *B* is fastened to the headstock with the screws shown at *C*. The upper part of the bracket is bored to receive the bar *D* which is a sliding fit in the hole, and the small end of the bar is slotted to take the lug on the back of the indicator *G*, a screw being used to hold it in place. The screw *F*, with its turned end located in the longitudinal slot in part *E*, keeps the indicator in a convenient position for reading. The upper surface of the turret face on which the counterboring tools are located, is tapped to receive the stud *H*. Rod *K* slides in a hole in the upper part of this stud and may be adjusted and secured in the required position by the binder-screw *L*. As both bars *D* and *K* are adjustable, considerable latitude is possible, and there are no points that are likely to interfere with other tools.

Accurate Facing on a Drill Press

Sometimes an accurate facing operation is required on work that can be handled most conveniently on a drill press, as is the case with the work shown in Fig. 3. The

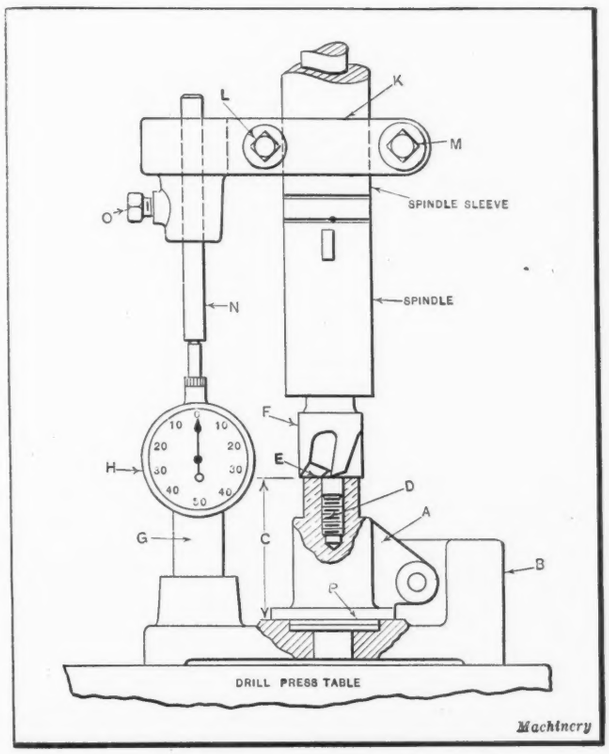


Fig. 3. Set-up for spot-facing on Drill Press

work *A* is a bracket casting of alloy bronze, which has been previously machined at the end *P* and drilled but not tapped at *D*. The dimension *C* is held within limits of + 0.0000 and — 0.0005 inch, which is extremely close work. As this was a government job the work was watched very strictly by the inspectors on account of its importance, and pieces that were outside the specified limits were ruthlessly "scrapped."

The work was held in a simple fixture *B*, being located on a finished surface *P*, and suitably clamped. A stud *G* in the fixture was arranged to hold the indicator *H*. The bracket *K* is bored out to fit the spindle sleeve, and it is slotted so that it can be easily clamped by tightening the binder-screws *L* and *M*. A hardened steel rod *N* is held in a vertical position, and can be adjusted by the set-screw *O*. In using the device, the operator sets the collar stop on the spindle sleeve approximately to the correct height, as determined by careful measurement, so that the counterbore *F* will face the end of work *E* nearly to the finish point. Then by forcing the hand-feed lever, the final accurate size is obtained, after which the indicator is set at zero in the usual manner, and all set-screws are tightened. When operating, the workman simply watches for the pointer of the indicator to reach the zero mark, using considerable pressure on the hand-lever. It was found that this method gave perfectly satisfactory results even when comparatively unskilled operators were employed.

* * *

To anyone who had not followed closely the recent developments in heavy motor vehicles abroad, the number of six-wheeled trucks exhibited at the commercial motor show at Olympia in England was a surprise. There were more than a dozen different three-axle trucks on exhibit. The six-wheel truck has attained great popularity in Great Britain because of its ability to handle heavy loads.

STAND FOR INDICATING ACCURACY OF SQUARE

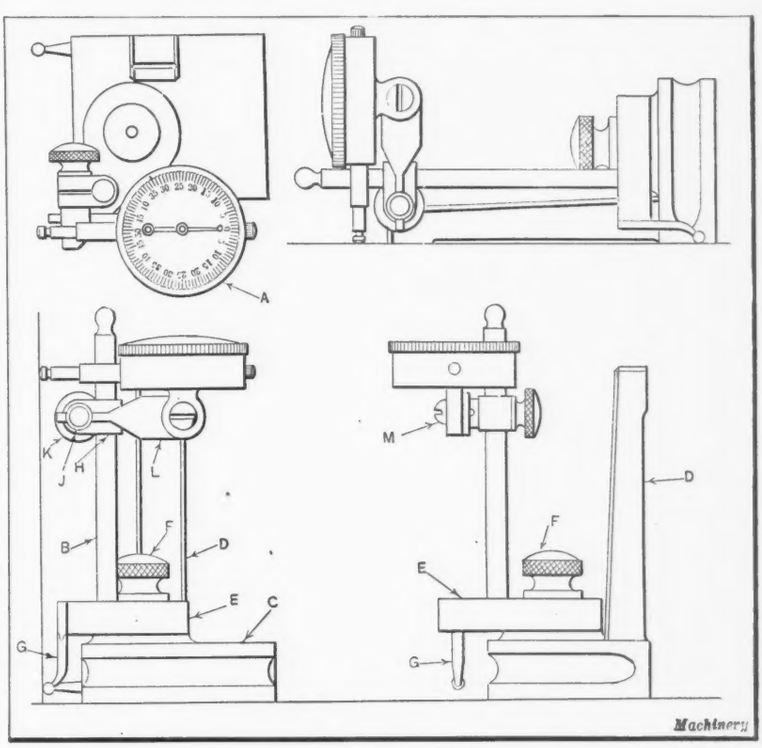
By E. E. LAKSO

Very few of the solid or combination squares employed in machine shops remain absolutely accurate if used continually. Squares of these types do not, of course, show the amount that the work is out of square even when they are accurate. In the accompanying illustration is shown a stand designed for the purpose of indicating a square or a piece of work having surfaces at right angles to each other. This stand is also used in place of a surface gage base for indicating different kinds of work. Practically any dial indicator can be used in place of the one shown at *A*. The indicating post *B* can be made any length to meet requirements.

The base *C* and the perpendicular part *D* should be made of steel. The base should be hardened and accurately ground. The plate *E* should also be ground to provide a good seating face on the base, as it pivots on a stud which has a spring tension thumb-nut *F*. The contact point *G* is fastened to the plate *E*. The post *B* is pressed into a hole in plate *E*, and is made to accommodate the ordinary surface gage clamp unit consisting of pieces *H*, *J*, and *K*. This clamp locks the arm *L* that holds the indicator *A*. The indicator, in turn, is secured to the clamp by means of the screw *M*.

In using the stand, the indicator is first clamped to the post at the proper height for the work to be indicated. The stand is then placed on its side so that the finished pads on the perpendicular column *D* rest on a surface plate or other true flat surface, as shown in the view in the upper right-hand corner of the illustration. Thumb-nut *F* is next loosened enough to permit plate *E* to be swiveled a quarter turn so that the contact point and the indicator button both bear on the surface plate. The zero point on the dial is then turned to correspond with the point of the needle, after which the stand is placed upright and the plate swiveled back to its former position where it is ready for use.

The accuracy of this stand depends upon the upper and lower faces of the base; a very high degree of accuracy may be obtained by surface-grinding these parts.



Device for indicating Accuracy of Square

Drawing Double-walled Steel Shells

By ROBERT BARRY HICKEY

THE dies illustrated and described in this article are employed in the production of steel shells of the shape and size indicated in the sectional view at *G*, Fig. 1. These shells are used in connection with an auxiliary mechanism of an alternating-current motor, and are generally known as "spring barrel tubes." The shape of the work after each consecutive press operation is shown in Fig. 1. The dies, arranged in the order in which they are used, are shown in Figs. 2, 3, and 4. Seventeen operations are required in the production of the finished shell. These include blanking, drawing, annealing, trimming, planishing, flanging, forming, perforating, burring, and upsetting. In the following description, however, only the press operations required in blanking, drawing, redrawing and forming are described.

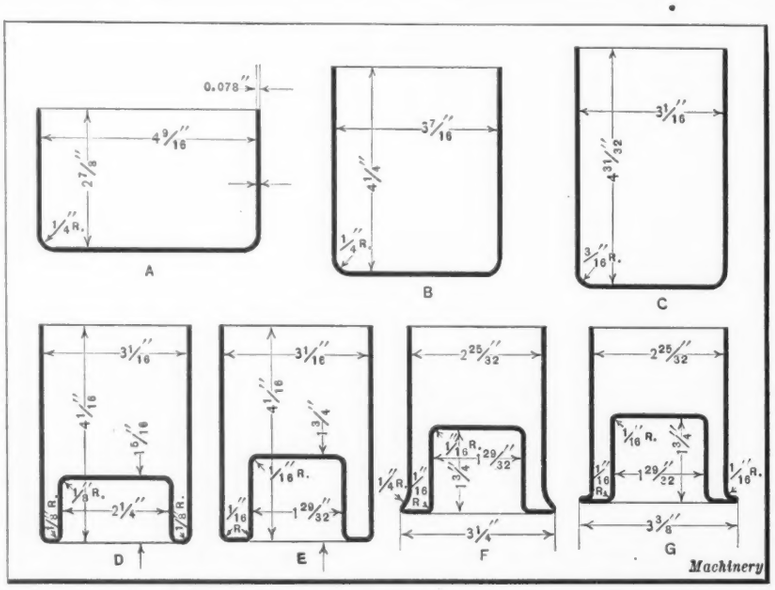


Fig. 1. Views showing Shape of Drawn Steel Shell after Each Consecutive Operation

The area of the blank is 55.088 square inches, and the blank diameter 8⅜ inches. The area of the blank is equal to the area of the inside of the completely drawn shell plus the part trimmed from the end, which has an area equal to that of a ring ¼ inch wide with an inside diameter of 3 1/16 inches. The material from which the shell is drawn is cold-rolled steel, 0.078 inch thick. Reference to the detail *A*, Fig. 1, will show that the depth of the shell produced in the blanking and drawing operation does not exceed three-fourths of the diameter, which is in accordance with the practice of the Century Electric Co., St. Louis, Mo., where these shells or "spring barrel tubes" are made. If the material is free from flaws, there is no loss due to breakage of the shells in the blanking and drawing operation.

In Fig. 2 are shown the dies used in the first two operations. The blanking and drawing die for the first operation is set up in a double-acting press, and the upper cutting member *A* is bolted to the ram. After this member has performed the blanking operation, it dwells for a sufficient length of time to hold the blank between its face and the

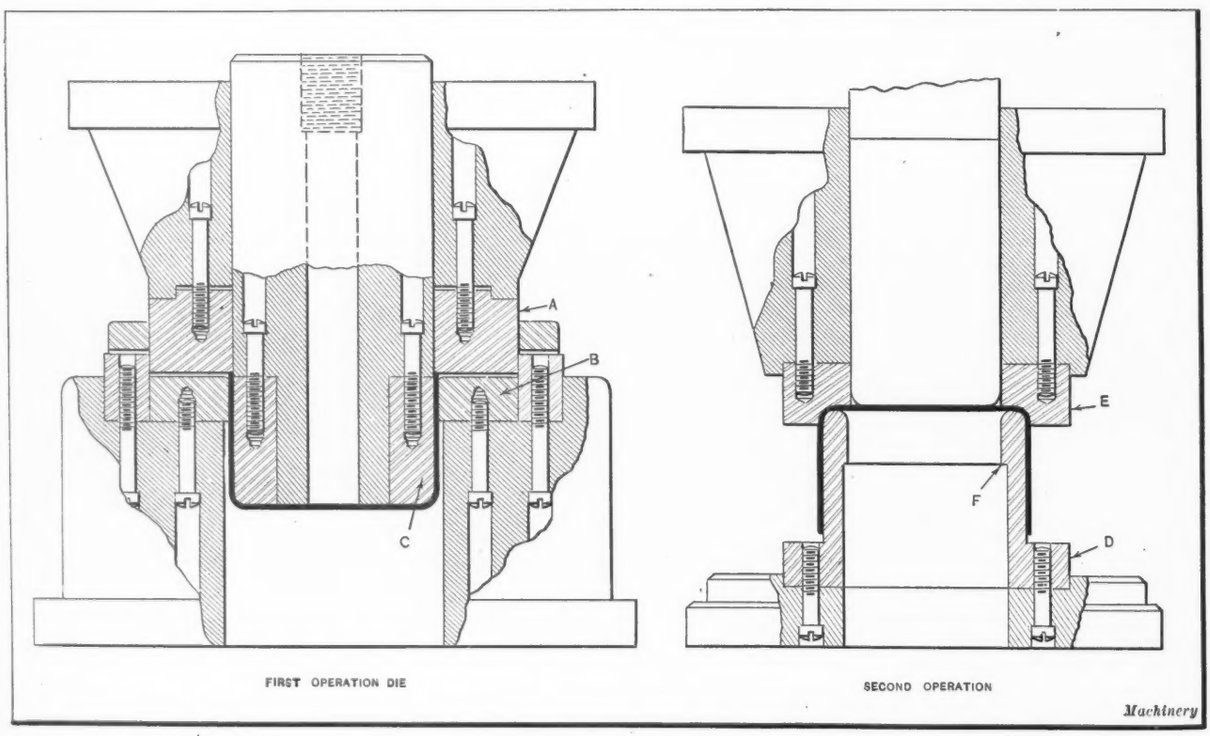


Fig. 2. First-operation Die which blanks and draws Shell to Shape shown at A, Fig. 1; and Second-operation Die which turns Shell Inside Out and draws it to Shape shown at B, Fig. 1

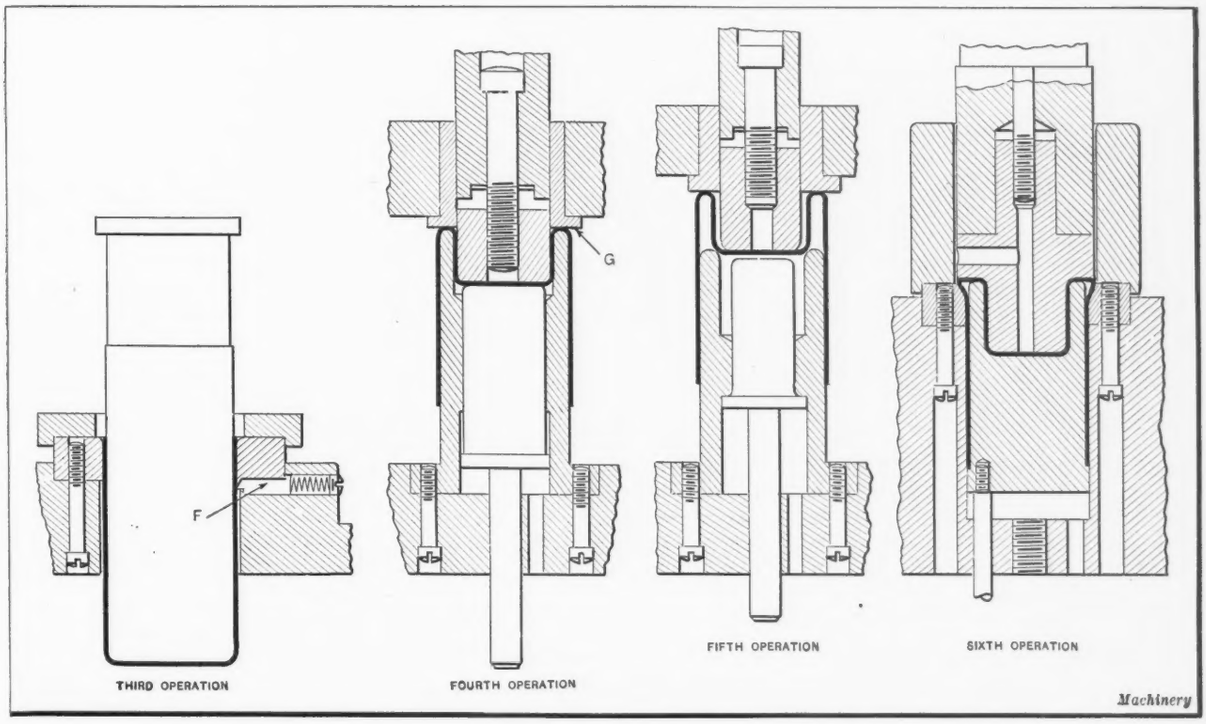


Fig. 3. Dies used in drawing and forming Shells to the Shapes indicated at C, D, E and F, Fig. 1

face of the drawing die *B* while the anvil *C*, which is attached to the press plunger, descends and draws the shell. The diameter of the anvil is less than that of the inside of the drawing die by an amount equal to twice the thickness of the metal plus 1/32 inch. This clearance is sufficient to allow the shell to drop from the anvil when it has passed through the die.

The die used for the second operation is also operated in a double-acting press. In the second operation, the shell is turned inside out. The lower die *D* is cylindrical in form and has an outside diameter equal to the inside diameter of the shell produced in the preceding operation. The inside diameter of die *D* is made equal to the outside diameter of the shell produced in this operation, or 3 7/16 inches, plus twice the thickness of the stock. The top edge of die *D* is rounded to a radius equal to half the wall thickness.

The action of a reverse-drawing die of this type is particularly interesting. When the anvil descends and the drawing action begins, all that part of the shell that is visible moves upward. The metal appears to be climbing up the outside and over the rounded face of die *D* in much the same manner as one would expect of a tubular piece of rubber drawn under the same conditions. When the open end of the shell reaches the rounded end of die *D*, it has a tendency to wrinkle, but is prevented from doing so by the holding member or die ring *E*. If the punch is set to push the shell completely through the upper part of die *D* so that the edges are drawn below the shoulder at *F*, the shell will be drawn off the anvil and fall out through the opening in the die bed. However, it has been found more convenient to set the punch so that the upper end of the shell will not be carried below the shoulder *F*, and thus the shell will be withdrawn from the die as the punch ascends. The shell is then stripped off the punch or anvil by the ring *E*. The operator picks up the finished shell with one hand while placing the next shell on the die with the other.

The advantage of the reverse drawing method over the regular drawing method is that a greater amount of reduction in the diameter can be obtained. The amount of reduction in this case is 25 per cent. In redrawing the shell by the regular method, it is the practice to reduce the diameter not more than 15 per cent. The 25 per cent reduction in diameter is obtained in this case with practically no loss through shell breakage.

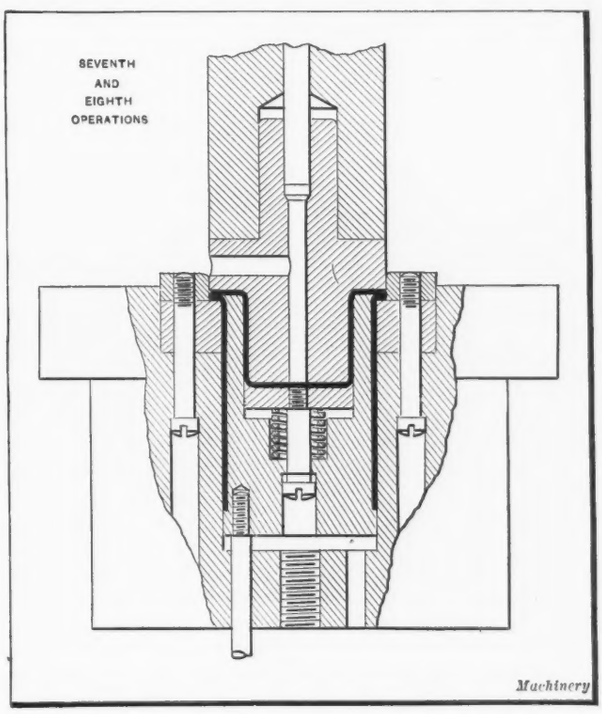


Fig. 4. Type of Die used for Seventh and Eighth Operations

The die used for the third drawing operation, which reduces the diameter of the shell to 3 1/16 inches, as indicated at *C*, Fig. 1, is shown in Fig. 3. This is a plain drawing die and does not turn the shell inside out, as in the previous operation. The amount of reduction is approximately 10 per cent in this case, and the diameter of the shell thus drawn is not reduced further until several other operations have been performed. This die is operated in a single-acting press, and the shell is pushed completely through the die and stripped off the anvil by three spring-actuated strippers, one of which is shown at *F*.

In the fourth operation, the bottom of the piece is pressed inward to form the double-walled shell, as shown at *D*, Fig. 1. The die used for this operation, which is shown in Fig. 3, resembles the die used for the second operation. The shell is drawn in the direction that would turn it inside out, but the operation of turning the shell is only partly carried out. The die is operated in a double-acting press. The function of the ram *G* is to strip the shell from the plunger member after the drawing operation. Member *G* is not required to prevent wrinkling in this case, because the drawing is not carried to the point where wrinkling would occur, as in the second operation where the shell is drawn up the outside and over the edge and down inside the lower die. The result of the fourth operation is the production of a shell within a shell, or what may be termed a "double-walled" shell. The diameter of the inner shell is 25 per cent less than the diameter of the outer one.

In the fifth operation, the inner shell produced in the preceding operation is acted on, and is treated as though the outside shell did not exist. The diameter of the inner shell is reduced approximately 10 per cent in this operation. No drawing action whatever is allowed to take place in the outer shell. The area of all that part of the shell that is inside the 3 1/16-inch diameter of the outer shell is not changed in the fourth and fifth operations.

In the sixth operation, the outer shell is reduced in diameter by being forced into a die, open end first. The effect in this case is to produce a head at the solid end, as shown at *F*, Fig. 1. The die used for this operation is shown in the view at the extreme right-hand side of Fig. 3.

In the seventh operation, the head formed in the preceding operations is flattened into a flange with a 1/16-inch radius where it joins the body of the shell, as indicated in the view at *G*, Fig. 1. The construction of the die used in performing this operation and also the eighth operation is shown in Fig. 4. The eighth operation reduces the 1/16-inch radius formed in the preceding operation at the junction of the flange and body to a radius of 0.005 inch. In the ninth operation, the end of the shell is punched out. The shell is annealed after the first and fifth operations.

* * *

MACHINERY TRADE WITH CHINA

Returns from China show an unusual increase in the total volume of machinery absorbed during the years 1921 and 1922, the figures indicating that in both these years about fifteen times as much machinery was imported as in 1915. The total value of the machinery imported in 1921 was $41,722,928, and in 1922, $41,387,239. Of this 38.6 per cent came from the United States and Canada in 1921, and 23.3 per cent in 1922; 38.7 per cent came from Great Britain in 1921, and 44.8 per cent in 1922. Prior to 1914, Germany occupied an important position in the machinery trade with China, being second only to Great Britain; but during the war Germany's share of the trade became negligible, and has not since assumed significant proportions.

Under war influences, American participation in the trade increased rapidly, and in 1919 and 1920, the United States and Canada led all other countries, with 44.7 and 54.1 per cent. In 1921 the share of business secured by Great Britain was about equal to that attained by American manufacturers, but in 1922 the American participation shrunk to about 23 per cent, while the British trade expanded to about 44 per cent. Evidently the serious competition for the machinery trade of China now lies largely between America and Great Britain. A Commerce Report points out that American manufacturers should give serious attention to the development of this trade and careful thought should be given to sales effort. It is believed that unless American machinery is supported in the world's markets with more aggressive and consecutive salesmanship, our engineering products will fail to hold the position that they merit.

CLAMPING BLOCKS FOR HOLDING DRIVING-BOX WEDGES

By H. H. HENSON

Clamping blocks such as shown in Fig. 1 have been found very satisfactory for holding driving-box wedges on planer beds for gang planing operations. The manner in which

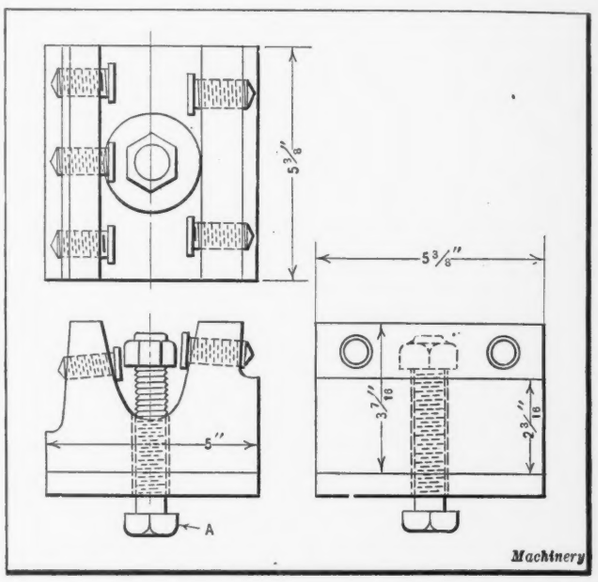


Fig. 1. Block used in clamping Driving-box Wedges to Planer Table

these blocks are used is indicated quite clearly in Fig. 2. In this illustration two rows of driving-box wedges *A* are shown mounted on the planer bed in such a manner that all the planing operations can be completed without changing the setting of the work. It will be noted that double tool-holders are used, enabling cuts to be taken on both sides of the work at the same time. The tool-holders are

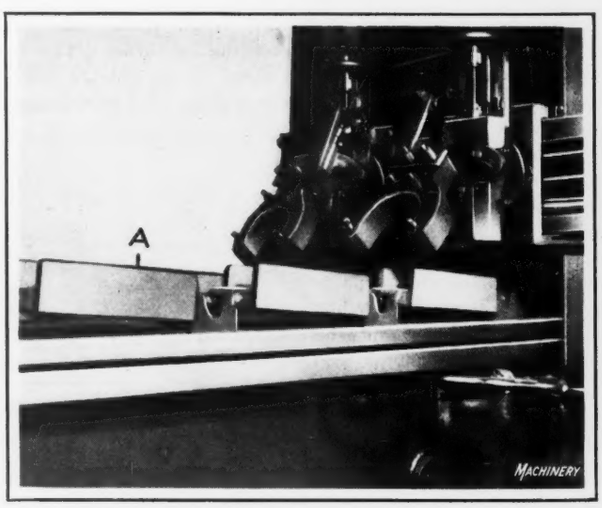


Fig. 2. Planer with Two Rows of Wedges clamped to the Table

provided with air hoists which automatically raise them to the position shown, on the return stroke of the planer table, so that the cutting tools will not drag on the work.

* * *

The exports of automobiles from the United States averages slightly over 10,000 passenger cars and between 2000 and 3000 motor trucks and buses per month. Australia is by far the most important market for passenger cars, taking from 20 to 30 per cent of the total exports. Argentina comes next in importance. The largest customer for trucks is Japan.

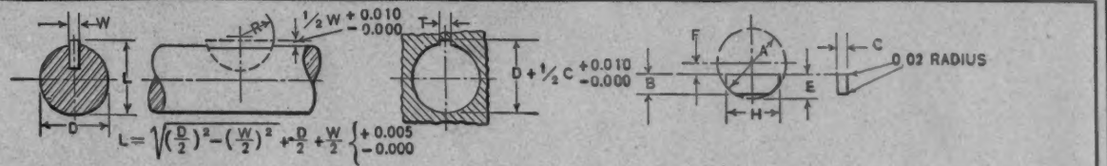


CUT OUT ON THIS LINE

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. ○ PUNCH

CUT OUT ON THIS LINE

WHITNEY KEYS AND KEYWAYS (WOODRUFF SYSTEM)—3



Key Number	Diameter of Key A		Height of Key B		Thickness of Key C		Length of Key H		Key Cut Below Center* F	D		Width of Keyseat W		Width of Keyway T	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.	Min.	Max.
126	2.125	2.135	0.390	0.396	0.1875	0.1885	1.370	1.380	21/32	0.401	0.406	0.1865	0.1875	0.1885	0.1895
127	2.125	2.135	0.390	0.396	0.250	0.251	1.370	1.380	21/32	0.401	0.406	0.249	0.250	0.251	0.252
128	2.125	2.135	0.390	0.396	0.3125	0.3135	1.370	1.380	21/32	0.401	0.406	0.3115	0.3125	0.3135	0.3145
129	2.125	2.135	0.390	0.396	0.375	0.376	1.370	1.380	21/32	0.401	0.406	0.374	0.375	0.376	0.377
26	2.125	2.135	0.515	0.521	0.1875	0.1885	1.713	1.723	17/32	0.526	0.531	0.1865	0.1875	0.1885	0.1895
27	2.125	2.135	0.515	0.521	0.250	0.251	1.713	1.723	17/32	0.526	0.531	0.249	0.250	0.251	0.252
28	2.125	2.135	0.515	0.521	0.3125	0.3135	1.713	1.723	17/32	0.526	0.531	0.3115	0.3125	0.3135	0.3145
29	2.125	2.135	0.515	0.521	0.375	0.376	1.713	1.723	17/32	0.526	0.531	0.374	0.375	0.376	0.377
Rx	2.750	2.760	0.578	0.584	0.250	0.251	1.995	2.005	25/32	0.589	0.594	0.249	0.250	0.251	0.252
Sx	2.750	2.760	0.578	0.584	0.3125	0.3135	1.995	2.005	25/32	0.589	0.594	0.3115	0.3125	0.3135	0.3145
Tx	2.750	2.760	0.578	0.584	0.375	0.376	1.995	2.005	25/32	0.589	0.594	0.374	0.375	0.376	0.377
Ux	2.750	2.760	0.578	0.584	0.4375	0.4385	1.995	2.005	25/32	0.589	0.594	0.4365	0.4375	0.4385	0.4395
Vx	2.750	2.760	0.578	0.584	0.500	0.501	1.995	2.005	25/32	0.589	0.594	0.499	0.500	0.501	0.502
R	2.750	2.760	0.734	0.740	0.250	0.251	2.307	2.317	5/8	0.745	0.750	0.249	0.250	0.251	0.252
S	2.750	2.760	0.734	0.740	0.3125	0.3135	2.307	2.317	5/8	0.745	0.750	0.3115	0.3125	0.3135	0.3145
T	2.750	2.760	0.734	0.740	0.375	0.376	2.307	2.317	5/8	0.745	0.750	0.374	0.375	0.376	0.377
U	2.750	2.760	0.734	0.740	0.4375	0.4385	2.307	2.317	5/8	0.745	0.750	0.4365	0.4375	0.4385	0.4395
V	2.750	2.760	0.734	0.740	0.500	0.501	2.307	2.317	5/8	0.745	0.750	0.499	0.500	0.501	0.502
30	3.500	3.510	0.921	0.927	0.375	0.376	2.870	2.880	13/16	0.933	0.938	0.374	0.375	0.376	0.377
31	3.500	3.510	0.921	0.927	0.4375	0.4385	2.870	2.880	13/16	0.933	0.938	0.4365	0.4375	0.4385	0.4395
32	3.500	3.510	0.921	0.927	0.500	0.501	2.870	2.880	13/16	0.933	0.938	0.499	0.500	0.501	0.502
33	3.500	3.510	0.921	0.927	0.5625	0.5635	2.870	2.880	13/16	0.933	0.938	0.5615	0.5625	0.5635	0.5645
34	3.500	3.510	0.921	0.927	0.625	0.626	2.870	2.880	13/16	0.933	0.938	0.624	0.625	0.626	0.627
35	3.500	3.510	0.921	0.927	0.6875	0.6885	2.870	2.880	13/16	0.933	0.938	0.6865	0.6875	0.6885	0.6895
36	3.500	3.510	0.921	0.927	0.750	0.751	2.870	2.880	13/16	0.933	0.938	0.749	0.750	0.751	0.752

*Dimension F is held within limits of + 0.005 and — 0.000 inch.

MACHINERY'S Data Sheet No. 31, New Series, April 1924

CUT HERE

PUNCH ○ Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. ○ PUNCH

TOLERANCES FOR STEEL RODS AND BRASS SHEETS

TOLERANCES FOR COLD-DRAWN TOOL-STEEL RODS AND BARS*

Grade of Steel	Kind of Rods or Bars	Finish	Size of Stock	Tolerance, Inch	Hardness Test: Brinell Maximum	Hardness Test: Sclero-scope
Carbon	Drill rod	Polished	Under ¼"	—0.00025	200	33
Carbon	Drill rod	Polished	¼" to ½"	—0.0005	200	33
Carbon	Drill rod	Polished	½" and over	±0.0005	220	36
Carbon	Drill rod	Lime Drawn	½" and under	±0.0005	200	33
Carbon	Drill rod	Lime Drawn	Over ½"	±0.001	220	36
Carbon	Round	Rough Drawn	½" and under	±0.001	210	35
Carbon	Round	Rough Drawn	Over ½"	±0.0015	228	38
Carbon	Round	Rough Drawn Annealed	½" and under	±0.001	190	32
Carbon	Round	Rough Drawn Annealed	Over ½"	±0.0015	210	35
Carbon	Flats or Shapes	Lime Drawn	All dimensions	±0.001	220	36
Carbon	Flats or Shapes	Rough Drawn	All dimensions	±0.0015	228	38
Carbon	Drill rod	Polished	All dimensions	±0.0005	250	42
Carbon	Drill rod	Lime Drawn	All dimensions	±0.0005	250	42
High Speed	Rounds	Rough Drawn	All dimensions	±0.001	250	42
High Speed	Flats or Shapes	Lime Drawn	All dimensions	±0.001	250	42
High Speed	Flats or Shapes	Rough Drawn	All dimensions	±0.0015	250	42

*Atlas Crucible Steel Co.

TOLERANCES FOR BRASS AND BRONZE SHEETS AND STRIPS (B. & S. Standard)

Thickness of Stock, American or Brown & Sharpe Gage	Thickness Tolerances for Different Widths: Up to 5 in., inc.	5 to 8 in., inc.	8 to 11 in., inc.	11 to 14 in., inc.
No. 0000 to No. 0 inc. (0.4600-0.3249)	±0.0044"	±0.0048"	±0.0051"	±0.0055"
Below No. 0 to No. 4 inc. (0.3249-0.2043)	±0.0039	±0.0043	±0.0046	±0.0050
Below No. 4 to No. 8 inc. (0.2043-0.1285)	±0.0034	±0.0038	±0.0041	±0.0045
Below No. 8 to No. 14 inc. (0.1285-0.0641)	±0.0029	±0.0033	±0.0036	±0.0040
Below No. 14 to No. 18 inc. (0.0641-0.0403)	±0.0025	±0.0029	±0.0033	±0.0037
Below No. 18 to No. 24 inc. (0.0403-0.0201)	±0.0020	±0.0024	±0.0028	±0.0032
Below No. 24 to No. 28 inc. (0.0201-0.0126)	±0.0016	±0.0020	±0.0024	±0.0028
Below No. 28 to No. 32 inc. (0.0126-0.0080)	±0.0013	±0.0017	±0.0020	±0.0024
Below No. 32 to No. 35 inc. (0.0080-0.0056)	±0.0010	±0.0014	±0.0017	±0.0022
Below No. 35 to No. 38 inc. (0.0056-0.0040)	±0.0008	±0.0012	±0.0015	±0.0019

MACHINERY'S Data Sheet No. 32, New Series, April 1924

A JOBBING SHOP COST SYSTEM

Readers of MACHINERY who wish to install a simple cost system in a jobbing shop, such as outlined in February MACHINERY on page 432, will be interested in the system used by the Urbana Tool & Die Co., Urbana, Ohio. In this system two forms or tickets are used in the shop, while in the office complete information relating to each job is recorded in two loose-leaf books.

Fig. 1 shows the labor ticket filled in by the workman, giving his name, clock number, and the date, and having space for the shop number of the job on which he is engaged, the number of the parts upon which the work is performed, the nature of the operation, the number of pieces completed, and the time required. These labor tickets pass to the office where the information is recorded on a labor sheet, which is shown in Fig. 2. On this sheet is given the customer's order number and the tool number given to this order in the jobbing shop. The name of the customer and the character of the work is recorded under the heading "Title," and the contract price is also given at the top of the sheet.

The Urbana Tool & Die Co.

No. 24 Date Feb. 11, 1924

Shop No.	Detail No.	OPERATION	No. Comp.	TIME
1810	10	Grinding	3	4
1814	3	Turning	12	5

Name John Black Total 9

Fig. 1. Daily Labor Ticket filled out by Workman

Each labor sheet is for one complete month and relates to one job or tool number only. A vertical column is provided for recording the time spent each day in the month by each workman engaged on the job, the names of the workmen being entered in the column at the left-hand side of the sheet. If a man has been working on the job during a previous month, the number of hours already completed at the beginning of the month are entered in the column, "Balance Brought Forward." In the column "Total Hours," to the right of the sheet, is given the total number of hours worked during the month. The balance brought forward from the previous month, is repeated in the column headed "Hours," and the column headed "Extension" gives the total number of hours on the job at the end of the month. In this way a complete record of the number of hours required for the work, together with the names of the men working on it, is obtained.

TOOL No. 1810 MATERIAL SHEET CUSTOMER'S ORDER No.

No. Lbs.	MATERIAL	COST	Date of Invoice	PATTERNS	COST	Date of Invoice	FORGINGS	COST
	Cold Rolled							

SUMMARY	COST	S. P.	GAIN
Labor	29 50		
Material	19 10		
Patterns	12 00		
Forgings	6 50	115	47 90
	67 10		

Fig. 3. Form on which Complete List of Materials is recorded

The form used for requisition of materials is shown in Fig. 4, and the loose-leaf sheet used in the office for recording completely all the material used on one job is shown in Fig. 3. In the lower right-hand corner of the latter is also given a "Summary" of the entire job. In this summary is entered the cost of all labor, stock material, patterns, and forgings. In the column "S. P." is entered the estimate or contract price, and in the column "Gain," the difference

Requisition No. A 952 THE U. T. & D. Co. Date 2/11/24

Tool Order No. 1810

STOCK							
QUANTITY	MATERIAL	DIAMETER	THICK	WIDTH	LENGTH	SET NO.	
1	Cold Rolled	1			6	1	
2	Tool Steel						

Signed Supt.

Fig. 4. Requisition for Materials

CUSTOMER'S ORDER No. 32205 LABOR SHEET TOOL No. 1810

TITLE

CONTRACT PRICE $115 00 MONTH January 1924

WORKMAN	BALANCE BRT. FORWARD																													TOTAL HOURS	HOURS	EXTENSION
TOTAL																																

Fig. 2. Sheet for recording All the Time spent on a Given Job

between the two, which indicates the amount available to take care of overhead.

Each month the total "Gain" on all the order numbers is added together, and from it are subtracted the total overhead costs for the month, the net gain thereby being determined. It is considered of greater value to know specifically the amount of the total net gain for the month than the net gain on each particular order. Hence, the overhead is not charged against each individual order, but against the total gain for the entire month on all orders. This system is simple and effective, and may prove of value to others engaged in a similar line of work.

* * *

MACHINE TOOL MEETING IN PHILADELPHIA

On March 25, an all-day meeting relating to machine tools and shop practice was held at the Engineers' Club of Philadelphia, 1317 Spruce St., under the auspices of the Engineers' Club and the Philadelphia Section of the American Society of Mechanical Engineers, with the cooperation of the Machine Shop Practice Division of the American Society of Mechanical Engineers. Two sessions were held, one in the afternoon and one in the evening. In the forenoon, an inspection tour was made of the U. S. destroyer tender *Dobbin* under construction at the Philadelphia navy yard. This ship, which will be placed in commission in a few months, is designed to meet all the ordinary demands for service, supplies, and repairs of a group of eighteen destroyers for a period of sixty days under war-time conditions. The necessary shop facilities for this duty are now being installed, and include a foundry, pattern shop, general machine shop, forge shop, and electrical, coppersmith, torpedo, and optical shops.

At the afternoon and evening sessions addresses were made by J. A. Smith, general superintendent of the General Electric Co., Schenectady, N. Y., chairman of the American Society of Mechanical Engineers' Machine Shop Practice Division; by B. H. Blood, general manager of the Pratt & Whitney Co., Hartford, Conn.; by Edwin J. Armstrong, assistant engineer of plant, William Cramp & Sons Ship & Engine Bldg. Co., Philadelphia, Pa.; and by W. H. Rastall, chief of the Industrial Machinery Division, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

Manufacturing to Close Limits

Mr. Blood's paper, entitled "Some Limitations on Manufacturing to Close Limits," dealt in considerable detail with the subject of specifying manufacturing tolerances in a practical manner. It also covered the subject of the conditions surrounding the taking of accurate measurements. Mr. Blood explained what precise measurements really mean, defined and pointed out the significance of tolerances in manufacturing operations, and cited several examples of close measurements. Precision in gear manufacturing was also referred to, and a gage for testing gears for involute tooth curves and spacing was described. Lantern slides were used to illustrate the talk. In summarizing his statements, Mr. Blood pointed out that in order to manufacture to close limits it must be possible to measure to still closer limits, and the following points were emphasized:

The measuring means should be as direct as possible.

Even where direct and accurate means of measurement are available, close work is expensive and should be asked for only when the expense is justified by the requirements.

Tolerances should be determined upon after a careful study of the required accuracy and the cost of obtaining such accuracy. If they are right, they should be adhered to; but when they are found to have been injudiciously set, they should be changed.

Cumulative tolerances should be avoided. In placing the tolerance figure on a drawing, the draftsman should consider how it can be checked. The observational error of the measuring instrument, and the influence of tolerances on other related dimensions should also be considered. Dimensions should be given from fixed and accessible points.

Greater clearances usually permit greater tolerances. If both can be increased with safety, there is greater economy in manufacture, and in many cases the product may be actually improved thereby. There is such a thing as "precision out of place."

Machining the World's Largest Hydraulic Turbine

Mr. Armstrong's paper described the methods used in machining the large cast-steel casings for the 70,000-horsepower turbines built by the William Cramp & Sons Ship & Engine Bldg. Co., and recently installed at Niagara Falls. The width across these casings is 47 feet 2 inches at the widest part, and 38 feet at the narrowest part, with a maximum height to the inlet flange of 15 feet 8 inches. They are made up of eighteen separate sections, each of which is very close to the maximum size for a rail shipment. The total weight of one casing, when assembled ready for boring, is 288 tons.

There are many other large heavy parts used in the construction of these high-powered hydraulic turbines, such as the cast-steel runners weighing 52½ tons, the head covers weighing 51 tons, and the cylinders and plungers for the valves weighing 46 and 37½ tons, respectively. These parts, however, although large and heavy, can be machined on the usual type of very large boring mills, having large-diameter tables and unusually high vertical distances from the table to the under side of the tool-holders. The casings, however, could not be machined in any ordinary manner, but special arrangements had to be provided, and these were described in detail by the author of the paper and illustrated with lantern slides.

The Machine Tool Export Problem

Mr. Rastall's paper dealt with an analysis of the prospects in various markets for selling American machine tools, and reviewed the sales methods necessary. It was pointed out that the opportunities for 1924 appear to lie particularly in two directions: First, in those markets that were formerly buying largely from Germany; and second, in those markets that are now being developed from comparative unimportance in the past. In pre-war years, such countries as the Dutch East Indies, Chili, and several of the other South American countries, depended largely upon German sources of supply for machine tools. Now that it is difficult for Germany to supply this trade, it is believed that the American manufacturer has a peculiarly favorable opportunity in these markets. The markets that show a tendency toward gradual development are those of Japan and British India, but it is claimed that recent experience in some of these markets indicates quite clearly that American machinery is not being pushed in these markets as much as its engineering merit deserves. In 1918 the United States furnished about 80 per cent of the machinery imported into Japan, but since then our participation has declined seriously. In British India the United States in the past has furnished as much as 25 per cent of the machine tool imports, but this percentage has also declined of late.

* * *

Eight out of every ten automobiles in the world are owned in the United States. There are more motor vehicles in the four states of New York, Pennsylvania, New Jersey, and Maryland than there are in all the rest of the world outside of the United States. At present there are 15,000,000 motor vehicles in this country, whereas there are less than 3,000,000 in all other countries. It is estimated that the American people are today spending more money for automotive transportation than for any other commodity or service except housing, clothing, and meat. The gasoline consumed exceeds 6,000,000,000 gallons a year.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, March 15

ALTHOUGH much disappointment is expressed at the falling off of business since the beginning of the year, it is generally agreed that there is little cause for depression. It is felt that there is a steadily growing demand, but that this demand will not progress beyond the potential stage until certain threatening aspects of the labor situation have subsided. Some sections of the engineering industry continue to report a steady improvement, and as a whole, there is nothing to suggest that we are falling back into the bad conditions of last year. It was extremely unlikely that the improvement that set in at the end of last year would be maintained at the same rate, and much of the present disappointment appears to be due to over-sanguine expectations.

The Machine Tool Industry

February has been a quiet month in the machine tool industry, but there are several indications that the market is slowly but steadily improving. There is still a marked disinclination to spend money on new machine tool equipment, but the number of firms who have orders to place is growing, and there is a much smaller amount of the type of inquiry that ends with the sounding of the market. Machine tool makers in some centers are better employed than for over two years past, and though they have a long way to go before they are working at anything like capacity, this condition may be reached much sooner than is anticipated. Manufacturers in a very large number of industries will eventually have to bring their plants abreast of the times, or find themselves unprepared for the keen home and foreign competition that a trade revival will foster.

The requirements in machine tools for the automobile industry do not seem to have been satisfied as yet, and there is in other industries an increasing demand for light manufacturing equipment, particularly small screw machines and turret lathes. An increased business is noticeable in drilling machines, while orders for power presses and sheet metal working tools are prominent among those recently placed. In several instances, firms engaged on machine tools for the railway car industry have their order books full, and new contracts are subject to long deliveries. One such firm is three months behind in its deliveries of some machines, and cannot give delivery on new contracts for certain lines of machines under twelve months. Makers of heavy hydraulic presses are also exceptionally busy on railway orders; and orders for car wheel lathes, turning and boring machines, and locomotive crank-axle turning lathes are also being placed.

Lathe makers in the Yorkshire area are working steadily, but business in standard lines does not show much of an increase. On the other hand, makers of radial drilling machines have had their stocks depleted considerably during recent weeks. Builders of vertical surface grinding machines are busy, and at least one firm works over-time. Two machines recently completed by this firm will grind castings up to 20 feet in length and are particularly intended for grinding the flat rails used in worsted machinery. Another grinding machine of this type has a 30-inch wheel and is employed for grinding the valves and mouthpieces used in gas work equipment. Makers of grinding machines for cutlery manufacturers are increasingly busy as a result of the growing use of such machines in Sheffield in place of the old method of hand-grinding at a grindstone. In Birmingham also, the grindstone is giving way to the abrasive wheel for the grinding of axes and similar edged tools. The type of grinding machine now being used for cutlery necessitates a final hand operation, but new machine designs now being developed will eventually enable hand operations to be superseded entirely.

Firms engaged in gear-cutting for the trade are well occupied, and small tool makers generally are able to keep their shops running at full capacity. Although the bulk of the orders for small tools still emanates from the automobile industry, the sources of the demand are widening and dealers are stocking small tools much more freely.

Overseas Trade in Machine Tools

The returns in the overseas trade in machine tools during January showed a heavy falling off. Exports have now fallen off for three months, totalling in January only 852 tons with a value of £92,546. In October, the corresponding figures were over 1660 tons with a value of £150,000. In January, the exports were only 65 per cent of the average monthly exports for the period 1911 to 1914. Imports in January totalled 204 tons with a value of £36,839. The tonnage of machine tool imports is only about half that of November last, but there was a surprising increase in the value per ton in January, the figure reaching £181. The average value per ton of imports during 1923 was £131, while that of exports was £108.

The best customer for British machine tools during the last quarter of 1923 was India, purchasing machine tools to the value of over £103,000. The next best customer was Australia with £62,000, and following these were Japan, Spain, and France. For one class of machines Japan was the largest customer, the orders for presses and punching and shearing machines totalling over £33,000.

Of countries sending machine tools into Great Britain during the last quarter of 1923, the United States was by far the largest contributor, the value of the machines being over £95,000. Germany was the next largest contributor with £33,000. Apart from France, which sold us machine tools to the value of about £10,000, the imports from other countries were insignificant.

The General Engineering Field

There are many encouraging signs to be noticed when a survey is made of the immediate prospects in the various branches of general engineering. In the Midlands a large amount of constructional engineering work is in hand for home railway developments, and these, coupled with various other constructional enterprises, including bridge building contracts, will keep structural engineers busy for a long time to come. For the new Shore Bridge, Sydney Harbor, the bid of Dorman Long & Co., Ltd., Middlesborough has been recommended for acceptance. The cost is stated to be about $20,000,000 and the work of construction will probably occupy ten years. The structure is about one mile in length and will require 50,000 tons of steel.

There is a very welcome revival of the engineering industry in Scotland. New contracts in this area are not confined, as they have so often been in the past, to the shipyards and marine engine shops, but range over a wide variety of activities involving millions of pounds.

Other business for which orders have already been placed or are likely soon to be placed include locomotives and other rolling stock for the Indian railways, shop equipment for the Portuguese Government railways, and electrical equipment for railway electrification projects.

Questions and Answers

GRINDING FLOUR MILL ROLLS

J. B. M.—Very little has been published in the past relating to the grinding and corrugating of flour mill rolls. An article on the methods used in performing this work would be appreciated.

This question is submitted to MACHINERY's readers.

DRAWING RECTANGULAR SHAPES

E. S. B. — Numerous articles have been published in MACHINERY relating to the making of dies for circular drawn shapes. The writer would like to see one or more articles illustrating and describing dies for drawing large rectangular shapes of medium or heavy gage stock, such as No. 10 or No. 12 gage.

LEAD COATING STAMPINGS

A. H. H.—What is the most economical method of lead coating small articles made from hot-rolled strip? After punching, the parts are pickled, dipped in a flux, and then immersed in hot metal consisting of two parts lead to one part tin. We cannot get a clean finish, because the scum from the top of the metal adheres to the articles.

PUNCHING SLOTS IN NUTS

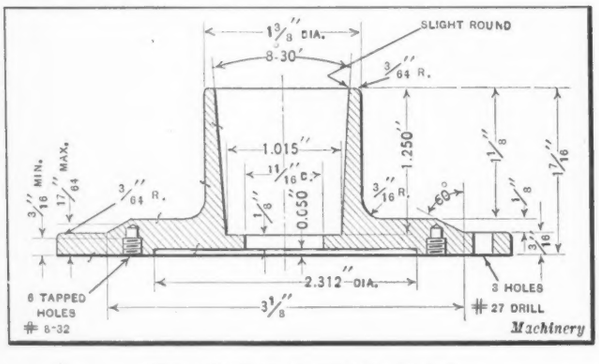
C. R.—I would be interested in a brief description of a device for punching the slots in small-sized castle nuts such as are used extensively on automobiles. These nuts are often slotted by a slotting saw, but what the writer wishes to see described is a method of punching them. Only devices already in use would prove of interest.

WHAT WOULD BE A FAIR PRICE?

R. N. Y. — The accompanying illustration shows a part made from brass of which 3000 were to be machined all over, the castings being furnished to the contract shop for machining. Bids were asked for, and when they were opened, it was found that the prices quoted varied all the way from 16 to 80 cents per piece. This example indicates the great variation in cost estimates in different shops. Some readers of MACHINERY may be interested in estimating the cost per piece of machining a casting of this kind complete, including drilling and tapping the holes indicated. It will probable be conceded that 16 cents per piece is entirely too low a price, while 80 cents is rather high.

ANSWERED BY JOHN J. BORKENHAGEN, CICERO, ILL.

Assuming that the casting is yellow brass and that the contract shop is equipped with a well designed turret lathe, 16 cents for machining each casting is a fair price for both the contractor and the purchaser. With an order for 3000 of these castings at this price, the contractor could furnish the tools required and make a good profit, figuring on a 100 per cent burden. The writer is under the impression that the contract shop that submitted the estimate of 80 cents each was only equipped with an engine lathe, and therefore could not handle the work on an economical basis. It might be mentioned that box-tools provide an ideal means of machining a piece of work of this kind on a turret lathe.



Brass Casting to be machined all over

POWER REQUIRED FOR DRAWING SHEET METAL

E. S. B.—The following questions are submitted to the readers of MACHINERY:

1. Is there any formula for determining the horsepower required for drawing shells of given diameter and thickness of metal?

2. Is there any rule for determining the pressure required to strip stock from a blanking or piercing punch in sheet-metal work, especially when a spring stripper is used?

3. What pressure should be exerted on a blank by a blank-holder when drawing shells of circular or irregular shape, taking the thickness of the stock, the depth of the draw, and the dimensions of the finished part into consideration?

METHOD OF MAKING THREAD GAGES

L. A. R.—I would like to obtain some general ideas as to the kind of steel that is used for working thread gages made in quantity, and the general procedure in making these gages; that is, how much allowance is made in threading for lapping or grinding to size.

A.—For thread gages up to ¼ inch in diameter, the thread is cut in a lathe to within 0.0005 to 0.0007 inch of the correct size. The steel used is a 0.20 per cent carbon cold-rolled steel, which is then carburized, reheated for hardening, quenched in oil, and finally lapped to size.

Thread gages from ¼ to 1 inch in diameter are made from the same steel and treated in the same way as the smaller gages, except that 0.001 inch is left on the diameter for lapping. On gages over 1 inch, from 0.0015 to 0.002 inch is left for lapping. These figures apply to U. S. standard thread gages.

In some cases, thread gages are ground to size instead of being lapped. In that case, the thread may be milled in a thread milling machine, leaving 0.005 inch for grinding. Otherwise, the classes of steel and its treatment are the same as mentioned in connection with lapped thread gages. It is the practice of some manufacturers to lap gages that have less than sixteen threads per inch and to grind those that have a coarser thread, provided the diameter is larger than ⅜ inch. Thread gages less than ⅜ inch in diameter are lapped at present, but it is likely that the smaller sizes will also be ground in the future. These directions relate to thread plug gages.

Very large thread gages are sometimes made from 0.90 per cent high-carbon steel; these gages are not hardened. They are first roughed out, then heat-treated, and finished after the heat-treatment.

In the case of thread templets, 0.20 per cent cold-rolled carbon steel is used. The general practice is as follows: For thread diameters of less than 1 inch, the thread is tapped out; for thread diameters larger than 1 inch, the thread is cut or chased in a lathe. After having cut the thread either by tapping or chasing, the thread templet is carburized, reheated for hardening, quenched in oil, and then lapped to size.

MACHINING CELLULOID

H. R.—The writer would like to obtain some information on the subject of machining celluloid, especially by milling operations. What are the speeds of the cutters, the lubricant used, if any, and what type of cutter will give the best finish? Additional information on other machining operations on celluloid would be appreciated.

HYDROLINE

J. M.—What is "hydroline" as mentioned in your article on "Saving Worn Parts by Electro-deposition" in November, 1923, MACHINERY, on page 202?

A.—"Hydroline," or "hydrolene," is the trade name given to the petroleum pitch remaining after the cracking of petroleum oil. This pitch is usually graded as soft, medium, and hard, according to the melting point, which ranges from 50 to 150 degrees C., and over. Hydroline may be obtained from the petroleum refining companies.

HOW CAN BLUEPRINTS BE MADE TO ADHERE TO CELLULOID?

H. J. H.—If any reader of MACHINERY has been successful in developing a method for making blueprints adhere to celluloid, a detailed description of this method would be appreciated. The writer has tried glue, but when it dries it does not adhere to the celluloid. Shellac, when dry, cracks and also makes the celluloid curl.

ANSWERED BY G. I. WARE, LOS ANGELES, CAL.

In answer to H. J. H.'s question in March MACHINERY, I would like to say that paper can be made to adhere to celluloid by the use of amyl acetate. The surface of the celluloid is covered with the amyl acetate, and as soon as the surface becomes somewhat sticky, the blueprint is applied.

ANSWERED BY WM. MARTINS, MILWAUKEE, WIS.

In answer to H. J. H.'s question in March MACHINERY, "How Can Blueprints be made to Adhere to Celluloid?" the writer wishes to say that, in his experience, the only substance that will adhere to celluloid is celluloid cement. This can be easily prepared by dissolving celluloid scraps in acetone amyl acetate or any other suitable solvent.

ANSWERED BY W. W. TOPPING, SOUND BEACH, CONN.

In answer to the question asked by H. J. H. for a method of making blueprints adhere to celluloid, the writer would suggest silicate of soda or waterglass, which he has used with satisfactory results for attaching labels to glass and steel. This will also make aluminum sheets adhere to each other.

DEFINITIONS OF "PUNCH" AND "DIE"

F. G.—What are the true definitions of the terms "punch" and "die"? Are these parts defined with reference to their respective shapes or on the basis of their locations when in the operating positions?

A.—The term "die" is often applied to an entire press tool including both upper and lower members, but considering the names "punch" and "die" as used to designate parts or sections of a complete die, it is believed that these main sections ordinarily are classified with reference to shape, rather than by location, notwithstanding the fact that the punch is usually but not invariably the upper member. The following general definitions are offered:

A "punch," as the term is applied in pressed-metal work, is that part of a press tool which enters into an opening or cavity formed in the die section, as in drawing, forming, or blanking. The punch usually is the upper member, being attached to the press slide or ram, but it may be the lower member, as in the case of press tools of inverted design. Whenever the function of the upper and lower members is identical, as, for example, in embossing the sides of coins or medals, the upper die section would ordinarily be called the punch merely because the punch member of most dies occupies the upper position; nevertheless, it is form rather than location which, in general, is the distinguishing feature between the punch and its mating die. When the name "die" is applied to part of a press tool, it refers to the member that has an opening or cavity to receive a punch, for blanking, drawing, or otherwise forming whatever stock or part is confined between the punch and die members.

SHOULD A MODEL BE FURNISHED WITH A PATENT APPLICATION?

J. L. B.—I have completed an invention and intend making application for a letters-patent on it. Is it necessary for me to furnish the Patent Office with a model of the device?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

A model is not required nor will it be admitted as a part of an application, except when, on examination of the case by the primary examiner, it shall be found necessary or useful to a complete understanding of the invention. In such a case, the examiner will notify the applicant of the requirement. This will constitute an official action in the case, and further action will be delayed until the model has been supplied.

The model must clearly exhibit every feature of the machine that forms the subject of a claim of invention, but should not include details not covered by the actual invention or improvement, unless they are necessary to the working of the model. A model once filed becomes a part of the record of the application, and will not be returned to the applicant. The Patent Office rarely requires that a model be furnished, as a complete understanding of the invention may be had in most cases from the drawings required in all mechanical applications.

CYLINDRICAL PLUG AND RING GAGES

M. H. L.—What materials are used for plain cylindrical plug and ring gages, and what method would be used for manufacturing these gages in quantities for use as working gages in large plants? Information on the materials used for contour or profile gages would also be appreciated.

A.—Plain plug and ring gages may be made from a steel containing 0.50 per cent of carbon. When made in quantity, plug gages are machined in a turret lathe to a diameter of from 0.010 to 0.015 inch larger than the required size; ring gages are also machined in the turret lathe, with the same allowance for grinding and lapping. After machining, the gages are carburized, reheated for hardening, and quenched in oil; the inside is then rough-ground to the lapping size, leaving about 0.0003 inch for lapping on a ¼-inch gage, and about 0.0005 inch for lapping on a 1-inch gage, other sizes being in proportion. After grinding, the gages are left to season for about six months, and are then lapped to size. Very small plug gages are often made from drill rod; this is a high-carbon steel and may be hardened like any tool steel. The temper is drawn to 300 degrees F.

Contour, profile, or templet gages that cannot be ground after hardening are made from 0.20 per cent carbon steel. These gages, after having been machined as accurately to size as possible, are carburized and quenched directly in oil from the carburizing heat, in order to produce a skin-deep hardening. This method prevents distortion that would be likely to follow if the gages were first carburized, cooled, and then reheated and hardened. It is, of course, very important to prevent distortion on gages that cannot be ground after hardening. When contour gages are to be ground after hardening, they may be made either from 0.20 per cent carbon steel or from 0.50 per cent carbon steel. In either case, the gages, after machining, are carburized, reheated for hardening, and quenched in oil, after which they are ground.

COMPOUND TOLERANCES

A compound tolerance refers to those conditions where the established tolerances on more than one dimension determine the required limits. These exist in conjunction with the dimensioning of composite surfaces or those surfaces which are required to maintain a co-relation which cannot be expressed by a single dimension.

LEAD PROOF OF DROP-FORGING DIES

In making drop-forging dies, it is customary to take a so-called "lead proof" from the impressions in the upper and lower dies, in order to make sure that the forging will have the right appearance when it comes from the dies, and to ascertain that there are no defective places in the impression. In making a lead proof, the impressions of both the upper and lower dies are cleaned and dusted with powdered chalk, the dies placed on end and clamped together with large C-clamps, and the heated lead slowly and evenly poured into the dies until it fills the impression and gate. As soon as the lead has cooled, the dies are unclamped and the lead proof removed and examined. The lead proof will show any places on the forging that are not perfect, and, by weighing the lead, it is possible to ascertain the weight of the finished forging. Roughly speaking, two-thirds the weight of the lead proof will equal the weight of the finished forging. The shrinkage of lead is practically the same as that of steel, so that the finished forging will have practically the same dimensions as the lead proof.

MUFFLE FURNACES

The principle of muffle furnaces is to improve the quality of the steel by keeping the heated work separated from the combustion gases by the use of a "muffle" or separate container into which the work is placed. There is no doubt that this is advantageous under the usual conditions of firing a furnace. However, with a properly designed furnace and proper burning of fuel, the combustion gases may be made practically harmless to the steel. The muffle type of furnace is apt to have more oxygen in contact with the metal than the open heating-chamber type as the result of sealing the work. To prevent oxidation, charcoal is often placed in the muffle to generate a protective gas that will burn up the oxygen and thus prevent the steel from scaling.

BUOYANCY

Any body that is immersed in water or in any other liquid is subjected to an upward force equal to the weight of the mass of the liquid that is displaced by the body. This is true whether the body sinks or floats. The weight of a floating body is equal to the weight of the volume of the liquid that it displaces. The upward pressure on the body is known as *buoyancy*. It may be assumed to be exerted at the center of gravity of the displaced liquid, which point is known as the *center of buoyancy*. In a floating body, at rest on the water, the line joining the center of gravity of the body and the center of buoyancy is always vertical, and is known as the *axis of equilibrium*. If an external force causes this axis of equilibrium to occupy an inclined position, then, if a vertical line be drawn upwards from the new center of buoyancy to this axis, the point where it intersects the axis is called the *metacenter*. If the metacenter is above the center of gravity, the body is in stable equilibrium, and tends to return to the original position when the external force is removed.

MANGANIN

Manganin is an alloy containing manganese, copper, and nickel, which is used for electrical purposes; it possesses the peculiar property of not altering its electrical resistance with a change in temperature. This alloy, therefore, is used for wires in the construction of resistance boxes, electrical instruments, and standards. The composition which has proved most suitable for ordinary purposes consists of 85 per cent of copper, 12 per cent of manganese, and 3 per cent of nickel.

FORCE-FEED LUBRICATION

The development of high-grade automobile engines has led to the evolution of the full force-feed system of lubrication. These engines are equipped with a pump that takes the oil drainage from a reservoir at the bottom of the crankcase. This oil is pumped at a pressure exceeding the bearing pressure, or from 30 to 60 pounds per square inch, to the main bearings. From the main bearings, the oil passes through a hollow crankshaft to the crankpins, then through hollow connecting-rods to the wrist-pins, and through hollow wrist-pins to the cylinder walls, from where it falls back to the crankcase sump. Highly developed oiling systems are also used on steam turbines, crosshead-type Diesel engines, and reduction gears. These systems are of the full force-feed pressure type, equipped with filters, coolers, and settling tanks. Several types of filters are in use; some of these remove the dirt by forcing the oil through a layer of hot water. Such a filter cannot be used for a saponifying oil. Others strain the oil through toweling or wicking, while still others use a centrifugal separator to clear the oil of dirt, etc. Each type has its limitations and advantages.

LEAD BURNING

Lead burning may be defined as a form of autogenous welding, by means of which the parts to be united are joined by melting metal between them. This molten metal is obtained by heating the end of a strip of lead of the same composition as that of the lead plates to be united. The addition of metal at the joint is not actually necessary, but it serves to replace the material that is usually cut away before welding. The term "lead burning" is really a misnomer, because the lead is not burned so long as the welder does the work properly. The operation is essentially one of welding the lead with heat furnished by the combustion of hydrogen, and the technique of the operation is almost exactly the same as that of ordinary oxy-acetylene welding. Lead burning may be effectively performed with an oxy-acetylene welding torch, but great care must be taken, because the temperature of the oxy-acetylene flame is really too high for working on lead.

UNIT ASSEMBLY

Many machines are so designed as to form a combination of semi-independent mechanisms which may be assembled and tested individually before they are assembled as parts of the complete machine. This is known as unit assembly; it is of particular value for a plant which manufactures a varied product where such unit assemblies are interchangeable. An example would be a feed-box that could be used on several types of machines. This practice enables a plant to obtain the benefits of quantity production on these unit assemblies although the quantity of production on any one type of machine is small.

RIGHT- AND LEFT-HAND PATTERNS

Many patterns are required in pairs, and when it is not possible to reverse them, and have the centers of hubs, bosses, etc., opposite and in line, they must be made right- and left-hand. If the pattern is a small one or if a great many castings are to be made from it, the better way would be to make two patterns, but if the pattern is large or if only one or two castings are required, the work should be laid out and planned so that the required pieces may be moved from side to side or from end to end in order to change the pattern from right- to left-hand.

COATINGS FOR LAYING OUT LINES

Common chalk or a mixture of whiting and alcohol is often employed in laying out rough castings in order that the lay-out lines may be easily seen. The whiting is sometimes mixed with water, but alcohol is preferable because it will dry quicker and does not tend to rust the surface. This mixture may be applied with a brush. For many purposes the surface can be coated satisfactorily by simply rubbing dry chalk over it. However, as lines which are drawn on a chalked surface are quite easily obliterated, permanence is given them by marking their location with small centerpunch marks. When iron or steel surfaces have been machined, they can be coated by moistening the surface and rubbing it with a piece of copper sulphate or blue-stone. The following copper-sulphate solution gives even better results: To 4 ounces of distilled or rain water, add all the copper sulphate that the water will dissolve; then add ten drops of sulphuric acid. Test by applying to a piece of steel and, if necessary, add four or five additional drops of acid. The thin copper film which is deposited by this solution makes it possible to easily see fine lines because of the difference in color between the copper and the metal beneath. For this reason, the copper-sulphate solution is very often used, especially when fine lines are required. The surface to be coppered should be polished and free from grease. Apply the solution with clean waste, and, if a bright copper coating is not obtained, add a few more drops of the solution; then scour the surface with a fine emery cloth and apply immediately a small quantity of fresh solution.

BRITISH THERMAL UNIT

The unit quantity of heat adopted in the English-speaking countries is the British thermal unit (B. T. U.). A British thermal unit is the quantity of heat that is required to raise the temperature of one pound of pure water one degree F. Strictly speaking, the measure or unit of heat is the quantity required to raise the temperature of one pound of water one degree, at its point of greatest density. Although this occurs at about 39 degrees F., it is customary, in ordinary computations, to disregard the temperature and to define a heat unit or British thermal unit simply as the quantity of heat required to raise the temperature of one pound of water one degree. The number of foot-pounds of mechanical energy equivalent to one British thermal unit is called the *mechanical equivalent of heat* and equals 778 foot-pounds. One foot-pound = 0.001285 heat unit. The various power equivalents of a British thermal unit are as follows: 1 B.T.U. = 1052 watt-seconds = 778 foot-pounds = 0.252 kilogram calorie (French or metric thermal unit) = 0.000292 kilowatt-hour = 0.000391 horsepower-hour = 0.00104 pound of water evaporated at 212 degrees F.

DIAMOND WIRE-DRAWING DIES

Dies made from diamonds are used extensively for drawing small sizes of wire. Such dies are now employed almost exclusively for wire ranging from 0.080 inch down to 0.0004 inch in diameter; and owing to their durability and other advantageous features, diamond dies are now finding quite a wide application for drawing larger sizes of wire. When they are properly made, the use of these dies is economical. Although their first cost is high, diamond dies retain their accuracy for a long time and they can be repeatedly recut, so that the item of die cost which must be charged against the expense of manufacturing wire, is distributed over a very large quantity of the product. For this reason, diamond dies have largely replaced the use of dies made from steel, iron, ruby, or sapphire. Most diamond dies are made of rough diamonds from the South African and Australian mines, the diamonds used for this purpose being of a grade which is unsuitable for use in jewelry. Diamonds from the mines are shipped chiefly to London, and from that market they are exported to different cities in France where the majority of the dies used in wire-drawing are made.

TERNEPLATE

Terneplate differs from tin plate in that the latter is sheet steel coated with commercially pure tin, while terneplate or roofing tin consists of sheet steel coated with an alloy of tin and lead. This alloy is usually composed of 32 per cent of tin and 68 per cent of lead; 26 per cent of tin and 74 per cent of lead; or 16 per cent of tin and 84 per cent of lead. Coating the steel with this alloy increases its weight about 20 per cent. Terneplates are made in sizes of 10 by 14 inches, and in multiples of that measure. The sizes generally used are 14 by 20 inches and 20 by 28 inches. The plates that are coated with an alloy containing from 26 to 32 per cent of tin are generally known as No. 1 terne, while those containing 16 per cent of tin are known as No. 2 terne.

CYANIDE METHOD OF COLORING STEEL

In using cyanide to color hardened steel, the work is immersed in the bath, brought up to its hardening temperature, and then transferred to a water bath for quenching. At the moment of quenching, the cyanide causes the quenching bath to become violently agitated as a result of the rapid transformation of small quantities of water to steam; this steam and the air drawn into the water by the agitation, partially oxidizes the steel in spots, giving the variegated colors, which are simply intensified tempering colors. While in the cyanide bath the steel is protected from the oxidizing effect of the air and it is also protected during its transfer to the quenching bath by a liquid film of cyanide which adheres to the steel and thus prevents the air from coming in contact with the work. The use of a cyanide pot for complete immersion of the work is more satisfactory than the method of sprinkling powdered cyanide on the work while it is being heated. Fair results can often be secured by the latter method, but more often the cyanide burns off and the steel is oxidized beyond the temper colors of, say, 650 degrees F. To increase the mosaic effect and obtain brighter colors, hardeners effectively employ either or both of the following methods: (1) Pass the hot steel through a water spray when transferring from the cyanide to the quenching bath. (2) Have a stream of air bubbling through the water in the quenching tank.

EDITORIAL COMMENT

on Mechanical Subjects of Current Interest

NEXT, EQUIP THE RAILROAD SHOPS

During 1923, our railroads bought an unusual number of locomotives and cars; over 4000 engines and about 175,000 freight cars having been added to their rolling stock. More freight than ever before in their history was carried, but even at the peak load the railroads had a very large surplus of cars. This year there will be no need for such large purchases of rolling stock, and the railroads can spend some of their revenue for necessary improvements in other directions.

The new equipment acquired last year will not long continue to give efficient service unless it is kept in good repair, and the most necessary expenditures at this time are for adequate repair shop facilities. During 1923 the railroads bought a moderate number of machine tools, and some shops installed much needed modern equipment; but many railroad shops that are still using obsolete machine tools must have new equipment if they are economically to perform their function of keeping the rolling stock of their road in good running order.

The net revenue of the railroads for 1923 considerably exceeded their annual revenue for many years past, and they occupy an unusually favorable position for rehabilitating their machine shops now. There is every indication that the traffic offered this year will be equal to or greater than in 1923, and by spending some of the net revenue for machine tool equipment now, to insure efficient operation, the railroads will save money for their stockholders in the future.

* * *

A HELP TO PROGRESS

Industries in which the manufacturers are most ready to interchange the results of their experience and who have the fewest trade secrets, have progressed more rapidly and have brought their products to a higher state of perfection, generally with a reduction in costs, in less time than have those who fear this kind of cooperation for competitive reasons.

The automobile industry is an example of extraordinarily rapid progress in a field where practically no mechanical secrets exist. The engineers, designers and production managers of the automobile plants meet several times a year at their conventions and at special meetings of the Society of Automotive Engineers, and the freedom with which ideas relating to design and shop practice are exchanged would be a revelation to many manufacturers and executives engaged in some other machinery industries. Articles relating to the practice in automobile plants are continually being published in the technical press, and it is of particular interest to note that the automobile builders who most freely cooperate in the exchange of ideas are usually among the leaders.

In some other industries a different policy prevails; very little information on either the design of the machinery built or the practice in the shops, is published or presented before conventions of engineering societies. It is noticeable that industries in which manufacturers are reluctant to give out any information, each one working out his own problems without the assistance that cooperation with others would afford, lack the incentive to adopt and utilize the latest developments in practice. Modern machine tools that have proved their value in other industries for similar work, have been introduced with difficulty or not at all. Those who give out no helpful information naturally receive none, and usually are not found in the procession of progress.

An interchange of ideas between shops engaged in the same industry, either through papers presented before engineering societies or through carefully prepared articles appearing in the technical press, helps both the writer and the reader. Some of the methods guarded as trade secrets are relics of the past, inferior to some of the advanced processes that have been developed recently.

* * *

BEGINNING YOUR LIFE WORK

Many young men who have not had the advantage of a systematic shop or technical training, and are ambitious to obtain better positions by self-education, are at a loss to know just how to begin and what to study. In making false starts, energy and time are wasted. Sometimes machinists take up mechanical drawing, thinking that the draftsman has a better job than the shop man. Frequently this is true. A man having designing ability may go farther in the drafting-room than in the shop; but many shop men who study drafting might ultimately go farther if they devoted the same time to the study of shop practice, the operation of different kinds of machine tools, and general manufacturing methods, with a view to becoming shop foremen and superintendents.

We cannot lay down a definite rule that will apply to all cases, but a man's inclination and liking for a certain kind of work should guide him, rather than the possible remuneration that he thinks a certain job may bring; for most men will go farther in work that they like than in that for which they have no particular inclination. Many boys have been made into mediocre lawyers and doctors, who, given a chance to learn a trade, might have developed into important executives in mechanical plants.

Sometimes the best opportunity for a young man happens to be near at hand, but wherever it may be, systematic training is required for the life work one selects. It is evident to those familiar with the variety of work in machine shops and metal manufacturing plants that it is impracticable to specify courses of study which will fit every individual. In one branch detailed knowledge of certain processes may be absolutely necessary, while in another it may be of little or no importance. But there are a few fundamentals that constitute the basic knowledge in all mechanical work which are absolutely necessary—as, for example, arithmetic, the use of formulas, the principles of theoretical mechanics, the solution of triangles, a knowledge of the different types of machine tools, small tools and other shop equipment, and the principles involved in their use. These are subjects that no one expecting to succeed in the machine shop field can afford to neglect. In these days excellent books are available to the ambitious young man who wishes to study in his spare time, and lack of opportunity can no longer be given as an excuse for ignorance of the fundamentals of the machine shop trade.

MACHINERY is always ready to advise any young man on the best course of study for him, if full information is furnished us about his education and training, and the kind of mechanical work he aspires to take up. If necessary, a course of study will be laid out to help him in making good use of his time and avoiding waste of energy and effort.

Assembling Sprinkler Heads

FOR expediting the assembly of sprinkler heads used in fire extinguisher systems, H. G. Carlson, superintendent of the Rockwood Sprinkler Co., Worcester, Mass., has developed an automatic machine of more than passing interest, which is shown in Figs. 1 and 3. There are six stations on this machine; the table that carries the work rotates intermittently while operations are being performed at five stations, and the work is reloaded at the sixth station.

Before proceeding with the description of the machine, it would be well to explain the construction of the sprinkler head. When the sprinkler head is closed, as illustrated in Fig. 2, a small cap is held over the large vertical hole in the lower part of the frame. This cap is held in place by the pressure exerted by the three members that are arranged in the shape of a triangle. Should the solder melt, as it does in the case of a fire, the triangle members collapse, allowing the cap to be forced off and the water to be discharged.

Pressure is exerted on the triangle members, and consequently on the cap, by tightening screw *A*, and it is important that the pressure be such that the cap will hold tight when a water pressure of 500 pounds per square inch is directed through the hole beneath it, but will "blow" under a pressure of 1000 pounds per square inch. Screw *A* is tightened and the sprinkler head tested at a special bench equipped with a water supply line and dial gages which indicate the pressure placed on the cap. When the screw has been tightened the proper amount, the sprinkler heads are placed on boards and taken to the automatic machine referred to.

Operations Performed in the Assembling Machine

Of the five operations performed in the assembling machine, the first consists of drilling a No. 53 hole for pin *C*, Fig. 2, which is drilled through one side of the frame and about half way through the screw. This pin prevents screw *A* from turning after it has been tightened the desired amount, as just explained. At the second working station of the machine a sufficient length of brass wire to fill hole *C* is fed from the overhead coil seen in Figs. 1 and 3 into a bushing in the work-holding jig. When the head reaches the third working station, a small-diameter punch pushes the pin into place. At the fourth station the end of screw *A*, Fig. 2, is cut off, and at the fifth station the projecting end of screw *A* is rounded back to rivet the deflector *B* to the frame. About 300 heads are assembled per hour with this equipment. The various mechanisms will now be described in detail.

Details of Construction of the Machine

At the loading position, the sprinkler head is seated in the work-holding jigs with the frame in a horizontal plane. Clamp *D*, Fig. 1, of each jig is held on the work by spring pressure from the time the jig leaves the loading position until it returns. This clamp is attached to a vertical bar, at the lower end of which there is a roll riding on a surface which is flat except at the loading station, where a cam forces the roller and clamp upward against the action of the spring. The drive to the machine is through a constant-speed pulley at the rear, which, when the clutch is engaged by manipulating handle *A*, drives, through worm-gearing, the horizontal shaft on which the drum cam *B*, Fig. 3, is mounted. At the forward end of this shaft there is a bevel pinion which drives a large bevel gear. The bevel gear rotates in a horizontal plane and meshes with pinions on the inner end of shafts that radiate to each of the other work-holding stations. Each of these shafts carries a cam that gives either a vertical or a horizontal movement to the various tools located at the different stations.

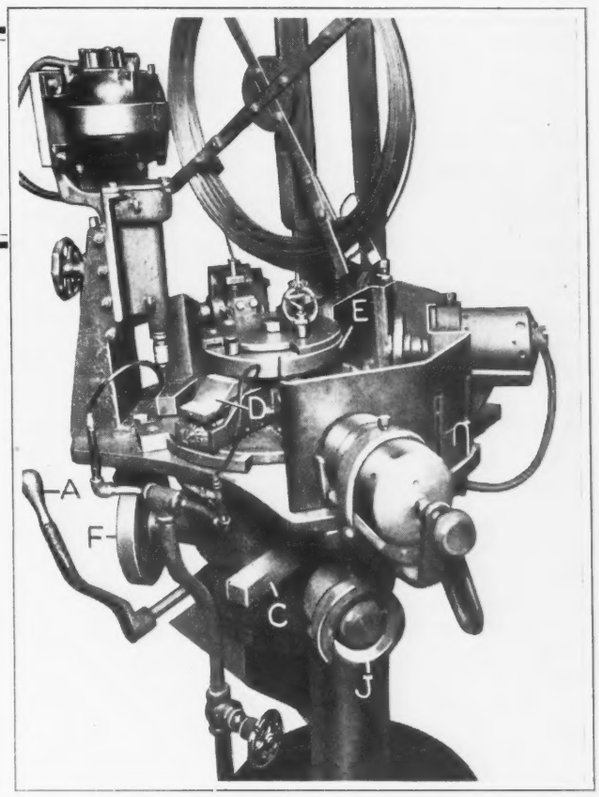


Fig. 1. Sprinkler-head Assembling Machine

The indexing and locking of the table are controlled by means of cam *B*. Attached to the bar *C* is a roller which comes into contact with strips on this drum, and thus, as the drum revolves, the bar is fed forward and backward. A spring-actuated finger fastened to this bar engages a different stud on the table during each forward stroke and thus imparts a rotary motion to the table, but on the return stroke of bar *C* this finger is disengaged from the studs so that the table remains stationary. As the table reaches the various stations, it is accurately located by a pin snapping into holes drilled around the table. This locking pin is mounted on a horizontal slide which is also actuated by cam *B*.

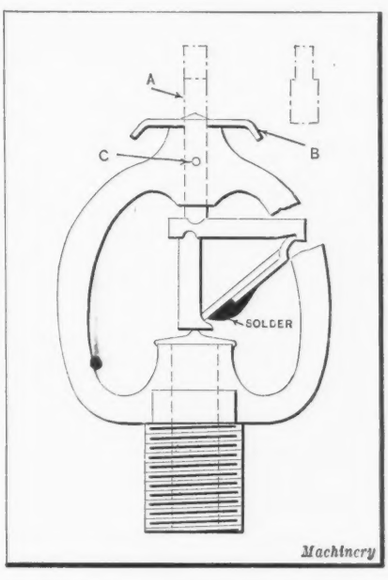


Fig. 2. Construction of the Rockwood Sprinkler Head

Drilling the Hole in the Sprinkler Head

For drilling hole *C*, Fig. 2, at the first working station, there is a drill spindle mounted on a vertical slide which is dovetailed in the bracket seen in Fig. 1. An individual motor for driving the drill spindle is mounted on the same

slide. The motor is of 1/10 horsepower, and runs at 1725 revolutions per minute, driving the spindle through spur gears at a speed of 2400 revolutions per minute. Vertical movements of the drill-spindle slide in the bracket are effected by a rod, attached to a rear extension of the slide, which has a roller at the lower end engaging with the face cam *F*. This cam is mounted on the shaft radiating from the center of the machine to this station.

The rear extension of the slide to which the roller bar is attached projects through a slotted opening in the bracket. The distance from the top of the drill bushing in clamp *D* to the nose of the drill chuck may be adjusted by shifting the position of the slide extension on the roller rod. A spring placed on this rod between the base of the bracket and a collar on the rod relieves cam *F* from raising the load after the operation. When the work is carried on to the next station, a jet of air is blown across the top of clamp *D* to remove the chips produced in drilling.

Inserting the Wire in the Hole

At the second working station the wire from the overhead coil is fed by means of rolls into a vertical bushing beneath which the bushing in clamp *D* registers as it is indexed to this station. Obviously there must be intermittent rotation of these feed rolls, and this is effected by means of a ratchet mechanism operated by a cam on the shaft radiating to this station. Springs force the vertical bushing tight against the bushing of clamp *D* to insure that the wire is fed into the latter bushing and that it will be sheared off when the table is indexed again.

Assembling the Pin in the Frame and Screw

The punch employed at the third working station to force the severed pin into the frame and screw of the sprinkler head is in a vertical position. This, too, is operated by means of cam strips on drum *B*, Fig. 3. A roller which rides on these strips is attached to the lower end of a rod connected to the rear end of fulcrum lever *G*. As the roller reaches the high points of the cam strips, this vertical rod raises the rear end of lever *G* and pushes the forward end down on the punch-holder, causing the punch to force the pin into place. A spring between the punch-holder and lever *G* keeps the roller in contact with the cam.

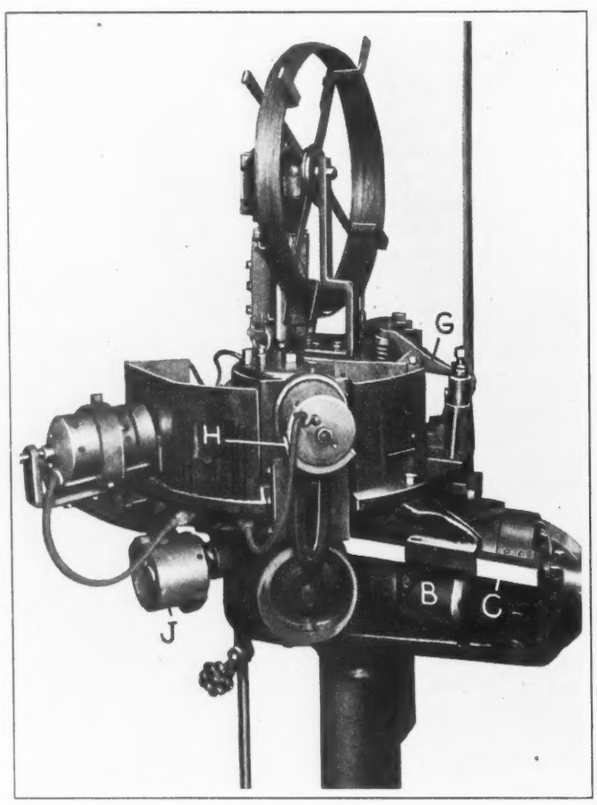


Fig. 3. View of Assembling Machine from the Right-hand Side

Cutting off the Screw and Rounding Back the End

At the fourth working station there is a circular saw mounted on the armature shaft of motor *H* for cutting off screw *A*, Fig. 2, as mentioned in the beginning of the article. The motor is attached to a slide that has a roller at the lower end engaging the path of the cam on the shaft radiating to this station. This cam lowers the saw until the screw has been cut through, and then raises it until the next piece of work has been indexed to this station. The motor is of one-quarter horsepower capacity, and runs at 1750 revolutions per minute.

An end-mill is employed in the fifth working station for rounding back the projecting end of the screw, as indicated by the solid lines in Fig. 2. This cutter is also driven by an individual one-quarter horsepower motor, mounted on a slide which receives a horizontal movement through a roller on the slide coming in contact with cam *J*, Fig. 3, on the shaft radiating to this station. This slide is dovetailed to the machine housing, and there is an adjustment for controlling the extreme advanced position of the cutter. The end of the screw is rounded centrally with respect to the prongs of deflector *B*, Fig. 2, by making the cutter shaft separate from the armature shaft of the motor and connecting the two by means of a strong spring. This construction permits the cutter-spindle to swivel to suit a collar surrounding the end-mill, which is shaped to suit the deflector. This collar is pushed forward under spring pressure against the deflector to centralize the work.

When handle *A*, Fig. 1, is operated to engage the clutch, a knife switch is closed by a mechanism on the shaft on which this handle is mounted, supplying current to the motors at the first, fourth, and fifth working stations for driving the tools. When the clutch is disengaged, the switch is disconnected.

* * *

DESTRUCTIVE VS. SERVICE TESTS

In a recent number of *The Dragon*, published by the Fafnir Bearing Co., New Britain, Conn., attention is called to the fact that some engineers are testing ball bearings by loading them to five or six times their rated capacities and noting the results. One engineer stated that in that way he got quick results, and saved a lot of time because no bearing lasted very long when he put that load upon it. This method of testing a ball bearing is about as effective as it would be to give a race horse a speed trial by harnessing him to a five-ton truck loaded with stone. The ideal test not only for ball bearings, but for every other industrial product, is to run it under actual service conditions. It is difficult to understand why engineers persist in submitting both bearings and tools to destructive tests which have no similarity to the actual service expected from the equipment. When the roadway of a highway is to be tested, an engineer would not think of running locomotives or steam rollers over it, but would note its performance under the ordinary load of automobiles, trucks, and horsedrawn vehicles from day to day. If he wanted to test the wearing qualities of a pair of shoes, he wouldn't put the leather soles against a grinding wheel, but he would put them on his feet and wear them. Yet, when he tests out ball bearings, he subjects them to a load never contemplated for these bearings in service, and the fact that they break down under that load has no significance in regard to their actual qualities in the service for which they have been designed. There are instances, of course, when it is not possible to make tests under service conditions, because the length of time required to make it possible to draw conclusions might be too long, but even then only a reasonable additional duty should be placed upon the devices being tested, in order to determine what their behavior will be under an occasional overload.

A Practical Drafting-room System

A Description of Methods Successfully Applied in the Management of a Drafting-room—First of Two Articles

By I. BERNARD BLACK

IN any drafting-room there must be a well thought out controlling system if the work of the department is to be carried on in an efficient manner. Such a system is necessary to expedite the development of designs and the making of working drawings, to eliminate confusion in filing drawings, prints, and other records, to insure the proper use of standards, and for many more reasons. In this and a subsequent article will be described a drafting-room system that has been put to a thorough test and found to be practical.

In the plant in which this system is used, there is a chief engineer who is the head of the engineering department. This man is responsible for the methods of manufacture, the lay-out of the plant, and the general supervision of the planning and drafting departments. The chief draftsman is an assistant to the chief engineer, and as such performs the supervisory and administrative duties connected with the drafting department, having general supervision over all draftsmen in the matters of attendance, absence, and conduct, and of the general procedure of all work performed in the department. He is held responsible for the proper and efficient use of the time of the draftsmen.

A careful record is kept of the time spent by each draftsman on the various jobs and also of the cost, and this information is filed so as to be readily available for future reference. The forms shown in Figs. 1 and 2 have proved suitable for recording this information, that shown in Fig. 1 being used for keeping account of the time involved in designing the component parts of a unit or machine. A card is made out for each part, but the time of more than one draftsman may be recorded on the card. This form gives such information as the names of men who have worked on the job, the time spent by each of them, and the individual and total costs. The form shown in Fig. 2 is used to keep a record of the time spent in designing a unit or machine and of the procedure of the work. The entire cost of the design can always be quickly obtained by means of the data recorded on this card.

Particular work in the department is assigned to the more experienced designers, who work either alone or with one or more draftsmen detailed as assistants. The designer temporarily in charge of such a group is held responsible for the strength and detail of parts and for the progress of the work. All draftsmen are required to familiarize themselves with the system followed in making drawings,

ORDER No.	COMPONENT			DRAWING No.			
DESCRIPTION							
		LAYOUT	DETAIL	CHECK	TRACE	CHECK	REVISE
NAME	DATE	HRS.	NAME	DATE	HRS.	NAME	DATE	HRS.
TOTAL								

Fig. 1. Form used for recording the Time spent by Draftsmen on Jobs

ORDER No.	COMPONENT		DRAWING No.
DESCRIPTION	ORDER REC'D		PROMISED
			DWG. DATED
			APPROVED

	NAME	STARTED	COMPLETED	DUE	TOTAL HOURS
LAYOUT					
DETAIL					
CHECKED					
TRACED					
CHECKED					
REVISED					

TOTAL COST	TOTAL HOURS
PATTERN DWG. COMPLETED	CASTINGS ORDERED
REASONS FOR DELAY	

Fig. 2. Card on which the Itemized and Total Costs of making Drawings are recorded

the manner of keeping the files, the routine of the department, the approved styles of lettering and dimensioning, etc.

Use of Stock Lists and Other Data Sheets

Machines, jigs, fixtures, etc., are designed in many drawing-rooms without considering the availability of the materials required for their construction. Such careless procedure not only results in delays occasioned by purchasing the necessary materials and awaiting their delivery, but also necessitates a larger total investment in materials. To eliminate loss from this source, all members of the engineering division in the establishment being considered are requested to make use, whenever possible, of materials tabulated on data sheets as being carried in stock. Deviations from this rule in the matter of common supplies must be sanctioned by the chief engineer. There are also data sheets of standard parts of dies, jigs, and fixtures; equipment information; and standard small tools. Information of a special nature not usually given in handbooks is also supplied to the draftsmen on standard data sheets.

General Practice in Making Drawings

As in practically every other mechanical drafting-room, the third-angle projection is used exclusively. There are only six sizes of drawing sheets permitted, five of which are made multiples of the largest size for convenience. The largest sheet measures 39 by 54 inches and is used for large assembly drawings. The next size is 27 by 39 inches, and is used for classified drawings, small assemblies, and large details; while the 19½- by 27-inch size is intended for large tool and fixture assemblies and details; the 13½- by 19½-inch size for medium-sized details; the 9¾- by 13½-inch size for small details; and the 6¾- by 9¾-inch size for drawings of small tools, such as counterbores, reamers, etc. The size of sheet to use is so chosen that the dimensions need not be crowded. The title rectangle shown in Fig. 3 is placed in the lower right-hand corner of the sheet within the margin lines, as in general practice.

Unless special permission is obtained from the chief draftsman, the only drawing scales to be used are full, one-half, and one-quarter size. The amount of detail shown in a drawing must be sufficient to convey to the shop a definite knowledge of what is required, but more than this is considered unnecessary and not permitted. If doubt exists regarding the clear definition of any part, an additional

view is required. This view may be placed above or below the proper position, provided an identification note is given so that a person working from the drawing may know at a glance just what the view represents. Whenever there are right- and left-hand similar parts, drawings of both parts must be made.

Line shading is followed only on assembly drawings, and surface shading only on drawings sent to customers, except in cases where the use of surface shading saves an additional view. Notes are used freely whenever they explain matters or save additional views. In cases where a lengthy explanation is desirable, the information is typed on a standard letter-size sheet, which is then blueprinted and a copy attached to the shop drawings.

It is contended that as the primary object of a drawing is to give the mechanic in the shop sufficient information to be able to make a part, this should be possible without his having to obtain additional information. For this reason all drawings must show sufficient dimensions to permit a full understanding without scaling, which is forbidden. The dimensions must be those that are used in the shop, and unnecessary dimensions must be omitted. Duplication of dimensions is permitted only when necessary to avoid a misunderstanding of details. Dimensions and angles must be so given that it will not be necessary for the mechanic to make any calculations whatever.

Another requirement is that a finished surface must be used whenever possible as a base from which to give important dimensions. If there is doubt as to the logical base, the chief draftsman is consulted. Naturally the shortest dimensions are always placed nearest the outline of the part for the sake of neatness. Poorly formed and indistinct figures are not tolerated, and while slight errors in scale are overlooked, absolute accuracy in regard to dimensions is demanded. A line is used to separate the numerator from the denominator of all fractional dimensions, and a dash is placed between combined foot and inch figures. All dimensions of component parts of machines, tools, fixtures, etc., are given in inches, while in all building, piping, and machine lay-outs, the inch is taken as a standard of length for dimensions up to two feet, and the foot from there on.

On each detail drawing is marked the number of parts of this type required for one complete working device or machine, together with other specifications concerning the part. A reference number is also given to the part, and this must appear on all assembly drawings in which the part is shown, the number in these drawings being enclosed in a circle about 5/16 inch in diameter, which is connected to the part by means of a light line terminated by an arrow head. This number is also made use of in notes, bills of materials, etc., to permit ready identification.

Fillets and Corners

All sharp corners formed by the intersection of two finished surfaces are rounded to a radius of approximately 1/32 inch if no dimension is given for the radius. In cases where parts fit together, the radius of the corner on the male part is made this dimension, and that of the female part slightly less. When the radii of corners and fillets are specified, the following should be used in order to avoid an unnecessarily large number of radius tools: corners, 1/32, 1/16, 1/8, 3/16, 3/8, 1/2, 3/4, 1, 1 1/4, and 1 1/2 inches; and fillets, 1/64, 3/64, 3/32, 5/32, 1/4, 3/8, 5/8, 3/4, 1, and 1 1/4 inches.

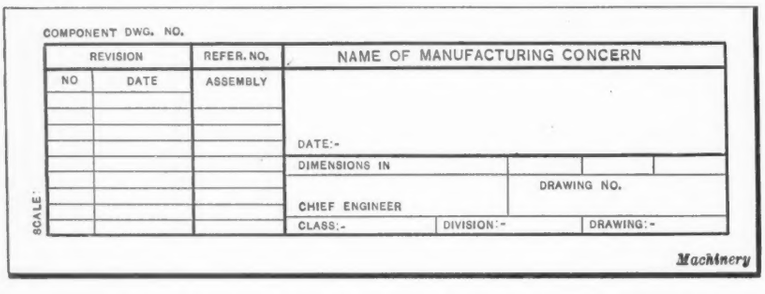


Fig. 3. Title Rectangle placed in the Lower Right-hand Corner of Drawings

Classification	Drg. Number	Kind of Drawing	
Full Title:			
Sent from D. R.		Received from Eng. Div.	

Fig. 4. Card filled out and placed in an Index to show where Drawing is filed

Clearances and Tolerances

Clearance between two mating parts is arranged for whenever practicable by giving a commercial standard dimension to the female part, and to the male part a dimension equal to that of the female part minus the desired clearance. Whenever practicable, standard bolts, nuts, and screws are used, and a clearance is not specified for these.

Tolerances are given on all important dimensions of component parts, except as follows: Lay-out dimensions, angles, diameters of bolts and screw holes not given on the standard sheets with tolerances, diameters of rivet holes, dimensions of screws and worms which must be fitted to a gage, and other dimensions marked "gage." In such cases the variations permitted are those of first-class machine shop practice, careful consideration being given to the function of the part and its relation to other parts. Tolerances are indicated in the usual manner by placing the permissible plus and minus variations in thousandths of an inch directly after the nominal dimension.

Finish Marks and Fits

The finish desired on surfaces is designated by means of numbers which refer to a certain degree of finish as follows: No. 1, rough cut; No. 2, light-cut round-nose; No. 3, finish cut; No. 4, file finish; No. 5, light polish; No. 6, high polish; No. 7, scrape; No. 8, spot; No. 9, rough grind; No. 10, finish grind; and No. 11, lap. Samples of each finish are posted in the manufacturing and engineering divisions for ready reference.

"Shrink" or "force" fits are designated on male parts, the amount being indicated by the difference in diameter between the male and female parts. A "snug" fit is applied to a male part that is to be inserted in a reamed hole, and indicates that the part be of such diameter that, while it can be turned, it is not free enough so that it can be shaken. A "free" fit is used only for drilled holes, and is taken to mean that there should be a clearance not exceeding 1 per cent of the nominal diameter. A "running" fit is applied to spindles or other parts rotating in bearings, especially in instances where a high finish is necessary and where greater accuracy is required than with snug fits. It will be evident that the fit is governed by the duty of the respective parts.

Checking Drawings and Making Tracings

After pencil drawings are completed, they are checked in all details, if possible, by another draftsman than the one who made the drawings, to insure correctness of all dimensions and details one with another, and compliance in such matters as nomenclature, general clearness, and distribution of views. In case changes are found necessary in any part that will affect the strength of the piece,

they must be brought to the attention of the designer in charge, in order that he may determine whether or not the part as changed will be strong enough. All changes are indicated by means of a colored pencil, and the original dimension crossed out. The checker is required to verify all computations made by the draftsman. Upon the completion of this checking and the correction of all errors, the drawing is signed by the checker, and then, but not until then, is the tracing begun. No alterations are allowed to be made by anyone upon a checked pencil drawing without the authority of the chief draftsman.

Tracings are made on the dull side of tracing linen with black ink only, colored inks not being permitted. All lines of tables are ruled on the smooth side of the linen, and numbers and letters inked on the opposite side, so that if changes in the figures or nomenclature should be necessary they can be quickly made without rubbing out any of the ruled lines. Titles, sub-titles, references to other drawing numbers, and all numbers or other marks given for filing purposes are placed on the drawings only in the office of the chief engineer. For this reason tracings sent to the engineering division for approval have only temporary lead-pencil titles and references.

When tracings are finished, blueprints are made from them for checking purposes, and to insure correctness, prints are again checked, preferably by another man than the one who made the tracings or checked the pencil drawings. After being checked and finally corrected, the initials of the draftsman, checker of the tracing, and the chief draftsman are placed in the title rectangle. Tracings are always dated before any prints are made for shop use, and prints made from an incomplete tracing for office use are immediately marked "For Office Use Only." When finally approved by the chief engineer and numbered, tracings are delivered to the file clerk.

LIST No.....

No.....of.....SHEETS

PER.....DATE.....

LIST OF PARTS FOR

ORDER No.....

Material	Quantity per Machine	Symbol	Dr. No.	Pattern Symbol	Description	Remarks

Fig. 5. Form on which the List of Drawings required for a Device or Machine is written

Giving File Numbers

Upon application, the file clerk furnishes to the draftsman a card such as shown in Fig. 4, upon which the draftsman enters the general and specific titles of the drawing. The file clerk then designates the proper class, division, and drawing numbers to be given to the tracing, and these are marked on the card and in spaces provided in the title rectangle of the drawing. In case doubt arises as to the proper class, division, or drawing numbers to be given a drawing, the matter is referred to the chief draftsman for his decision. The class number depends on the type of the part or design which the drawing shows, while the division number is a serial number of the various divisions of this particular class, the principal classes being: Class 1, plant construction; Class 2, component parts; Class 3, equipment; and Class 4, standards, general details, etc. The divisions into which these classes are subdivided would, of course, vary with different establishments. Taking Class 3 as an example, it may be subdivided according to the various types of machines in the plant, as, planers, shapers, and drilling machines.

A set of drawings consists of all those necessary to show the details and assemblies for a complete unit or machine. All such drawings are listed on a sheet like that illustrated in Fig. 5, which is shown torn off, so as to conserve space. The actual size of the form is 8½ inches wide by 14 inches long. Each drawing that shows a part of a particular unit or machine that is not used as a part of any other unit or machine, is given the same class and division numbers as are given to the sheet showing the list of drawings (Fig. 5), and in addition is given a serial drawing number in the particular class and division. However, any detail which is a part of more than one unit or machine is placed on a drawing in Class 4, and called a general detail.

When certain parts required for a unit or a machine are in a separate set of drawings, the drawings only of these parts and the list are included in the set of drawings developed for this particular unit or machine. When a new design is so great a departure from existing designs as to be of an experimental nature but has been built from some parts of other designs, the set of drawings includes only such details as are entirely different from existing ones, and a list numbered 1-A giving the parts used in other devices is included in the set. This list shows the parts used, together with the number used, and the piece, class, and drawing numbers and revision dates of the drawings. To distinguish such a set of drawings, the capital letter E is suffixed to the class number of the drawing and the word "Experimental" is placed in the title. Tracings of such experimental devices do not bear the approval of the chief engineer.

When the machine or device has been approved for service, the list of drawings is revised to include the omitted parts, the letter E removed from the class number, the word "Experimental" taken from the title, the list of parts omitted, piece numbers added, all old revision dates removed, and a new revision date set. The tracing is then sent to the chief engineer for approval. The second article which explains the remaining points of interest in this system will be published in May MACHINERY.

* * *

STEEL FOR GAGES

In some cases, a 0.90 per cent carbon tool steel is used for gages that must be finished rapidly. This steel is hardened by merely heating and quenching in oil in the way in which high-carbon tool steel is usually hardened; hence, the time required for the carburization and reheating that is necessary for the low-carbon steel often used for gages is saved. This high-carbon steel should have a composition of from 0.85 to 0.95 per cent carbon; from 0.25 to 0.35 per cent manganese; from 0.12 to 0.18 per cent silicon; and a phosphorus and sulphur content not exceeding 0.025 per cent. When used for gage work, this steel is heat-treated as follows: The gage is first roughed out to about ⅛ inch over-size, after which it is heated to from 1450 to 1475 degrees F., and quenched in oil. It is then drawn to 1200 degrees F. and permitted to cool slowly, at which time it should have a scleroscope hardness of from 40 to 45. It will be found then to have good machining qualities, and is finished by machining after heat-treatment. There is no heat-treatment after the gage is finished. If the manganese and silicon content is higher than specified in the analysis given, the hardening heat should be lower (about 1400 degrees F.) and the drawing heat should be higher (about 1250 degrees F.).

* * *

Usually our best work is that which we do easily and joyfully.

Ejectors for Punches and Dies

By HOWARD M. GROFF, Treasurer, Buch-Groff Co., Trenton, N. J.

SPRING-ACTUATED ejectors are the most commonly employed means of ejecting parts from the punches and dies of power presses. A difficulty sometimes encountered in the use of such devices is that, since the spring operating the ejection device is usually compressed by the down stroke of the press, ejection starts immediately upon the release of the pressure on the spring at the beginning of the up stroke, and in some cases, the work may be of such a nature that its ejection from the punch or die should be delayed until a portion of the up stroke has been completed. Spring-actuated knock-outs are undesirable in such instances, and a further disadvantage is that they are not positive in their action. Mechanical ejection devices, or knock-outs, can be utilized to better advantage in cases of this kind, owing to their positive nature and the varying adjustments that they permit.

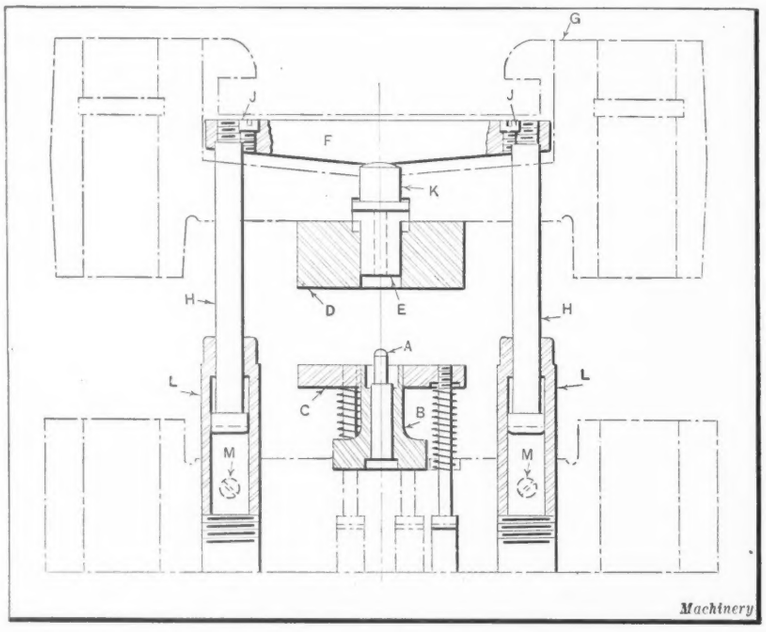


Fig. 1. Shaving Die equipped with Positive Knock-out

In Fig. 1 is shown an adjustable positive knock-out applied to a shaving die for small gears. The piece to be shaved is located on the pin *A* which is held in punch *B*. The spring-actuated stripper *C* strips the shaving from the punch while the part shaved is carried up with the die *D*. Near the top of the stroke the piece is ejected from the die by the positive knock-out *E*. Delaying the ejection of the part from the die permits the shaving to be removed from the top of the stripper by a blast of air and allows the press to be operated at a higher speed. The press is inclined so that the part drops out into a receptacle provided for it.

The knock-out, in this case, consists of a cross-bar *F* which floats in a recess milled in the punch-holder *G*. The two actuating plungers *H* are secured in place by lock-screws *J*. The cross-bar is in contact with button *K* and shedder *E*, which, after the piece has been ejected, is flush with the lower surface of the die. Plungers *H* reach down through the punch-block into the two studs *L*, which are bored out to receive the plunger heads. Studs *L* are milled to a hexagonal shape at the top to permit adjusting them with a wrench. When adjusted, these studs are locked in place by set-screws *M*.

The action of the ejector is as follows: As the die shaves the work on the down stroke, shedder *E*, button *K*, and cross-bar *F*, with the plungers *H*, recede until the com-

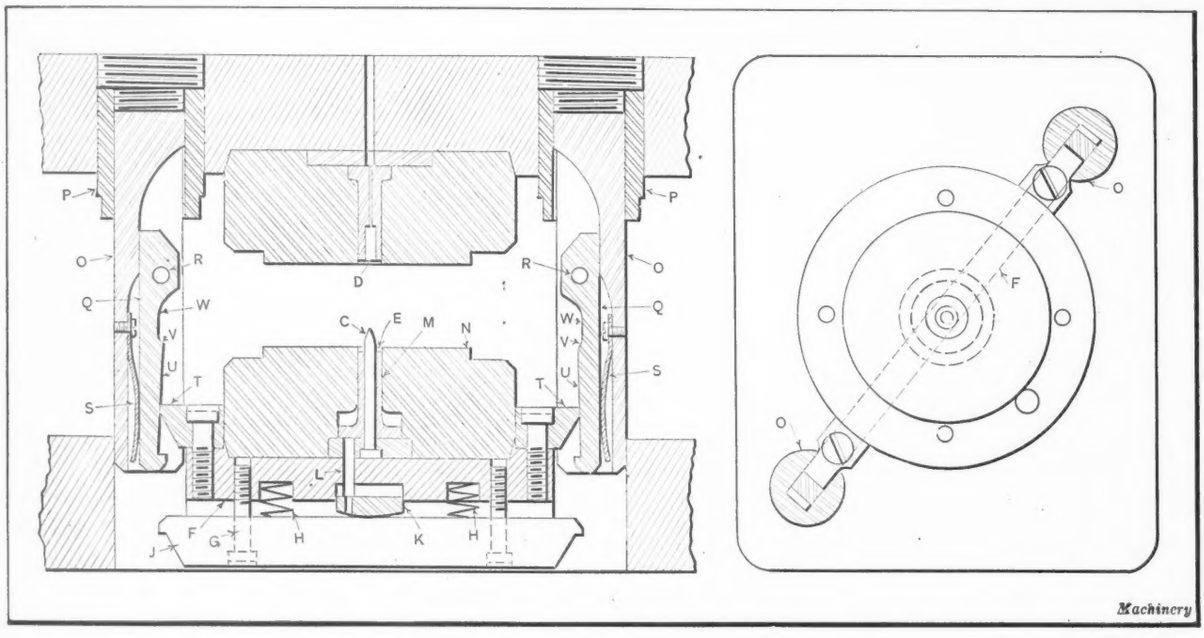


Fig. 2. Swaging Die provided with Positive Type of Work Ejector

pletion of the down stroke of the press. On the up stroke, the work is carried up with die *D* until the heads of plungers *H* strike the end of the enlarged holes in studs *L*. When this takes place, the upward movement of cross-bar *F*, button *K*, and shedder *E* is arrested, and as the die is still in motion on the upward stroke, the part is ejected from the die, leaving it ready to receive another part on the next shaving stroke.

Knock-out for Swaging Die

In Fig. 2 is shown a knock-out that has been successfully applied to a swaging die. The punch and die shown is used

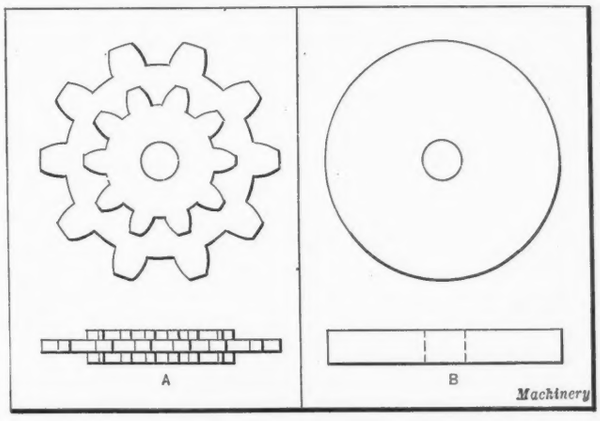


Fig. 3. Work swaged on Die shown in Fig. 2 and sheared or sized by Die illustrated in Fig. 1

for swaging the part *A*, Fig. 3, from the blank *B*. This type of gear has the teeth on the central flange sized in a shaving or trimming die, such as shown in Fig. 1. The blank *B*, Fig. 3, is located on the pin *C*, Fig. 2, for the swaging operation, in which the two hubs are swaged down into recesses at *D* and *E* in the upper and lower dies. As the swaging action closes in the metal around pin *C* (to insure accurate sizing of the hole) it is necessary that a device be used to eject the piece from the lower die. After ejection, the mechanism drops down to avoid interference when locating the next piece to be swaged.

The ejection arrangement consists of a cross-bar *J*, set in a recess or slot in the die-block. Adjustment screws *G* control the location of the bar, while springs *H* return it to the lower position after the piece has been ejected. In contact with the upper surface of the cross-bar *J* is a button *K* carrying shedder pins *L* which engage the shedder *M* in the die *N*. Two posts *O*, carried in adjustment bushings *P* in the punch-holder, have a longitudinal groove milled in them, in which are carried the ejection latches *Q*, pivoted on pins *R* and actuated by latch springs *S*. Two cam-fingers *T*, placed diametrically opposite each other on the top of the die-holder, enter the groove in posts *O*, and it is against the ends of these fingers that latch springs *S* hold the ejection latches *Q*.

Posts *O* are adjusted vertically to obtain the proper point of ejection on the up stroke, by turning adjustment nuts *P*, which have a right-hand thread on the outside and a left-hand thread on the inside. Nuts *P* are milled to a hexagonal shape on the lower end so that they are easily turned by a wrench, and they are locked by set-screws (not shown) in the punch-holder. Posts *O* are prevented from turning by the cam-fingers in the grooves.

Action of Swaging Die Knock-out

On the down stroke the cam-fingers *T*, riding over cam surfaces *U*, spread the ends of the ejection latches. When the cam-fingers reach the inclines *V* leading to the surfaces *W*, the ends of the ejection latches snap in below the overhanging lugs on the ends of cross-bar *J*. On the up stroke the cross-bar is lifted by the latches so that the work is ejected from the lower die, and as the cam-fingers *T* ride up incline *V*, the latch ends spread allowing the cross-bar, under the influence of gravity and springs *H*, to drop back into place while the punch-holder which carries the posts *O* continues the upward stroke.

When the work is placed in the die, the shedder *M* is level with the face of the die *N*, or in the case of a thick piece, slightly above it in order to shed the part from the pin. A little added pressure in locating the piece pushes this down flush with the die. No spring return can be provided for the shedder on this type of swaging die, since pressures as high as 350 and 400 tons are used. The die must, therefore, be constructed very solidly.

Positive mechanical ejectors such as the ones described can be used as valuable auxiliaries in pushing or ejecting parts from the dies into spring fingers on transfer arms, slides, etc., where the work is moved to a spot outside the dies, to be dropped into a magazine for subsequent operations or to be removed by hand.

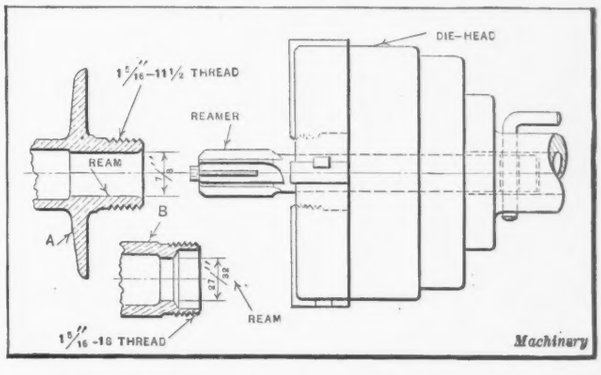
* * *

COMBINED DIE-HEAD AND REAMER

By ELMER C. COOLEY

The two ends of a brass casting which were required to be machined on a turret lathe are shown at *A* and *B* in the accompanying illustration. In tooling up the lathe for machining this casting, it was found that all six stations of the turret were required to hold tools. A change in the design of the part, however, made it necessary to perform an additional reaming operation and another threading operation. In order to meet these new requirements, it was decided to combine a threading die and a reamer in such a way that they could both be held in one station on the turret. The arrangement is shown in the illustration.

The die-head is a Geometric 1¼-inch style D, bored out to receive the shank of a solid reamer. The reamer shank is allowed to have a floating movement of about 0.010 inch, and is set ahead of the die chasers far enough to permit the reaming operation to be completed before the threading



Combined Die-head and Reamer for Use on a Turret Lathe

is begun. The results obtained with this combination tool are very satisfactory, and the writer believes that a similar combination of tools can be used to good advantage in many shops.

* * *

Power from mercury vapor, making possible a double vapor power plant in which turbines for generating electricity are driven both by mercury vapor and water vapor from the same fuel source, resulting in a gain of about 50 per cent in power per pound of fuel, is the outstanding achievement of a new boiler perfected by the General Electric Co., Schenectady, N. Y. Two such boilers have been built to date. One is an experimental apparatus operated at the Schenectady Works of the General Electric Co., and the other an experimental installation now under observation at the Dutch Point generating station of the Hartford Electric Light Co., at Hartford, Conn. This installation is the first of its kind in the world. Experiments have been conducted by the General Electric Co. over a period of years.

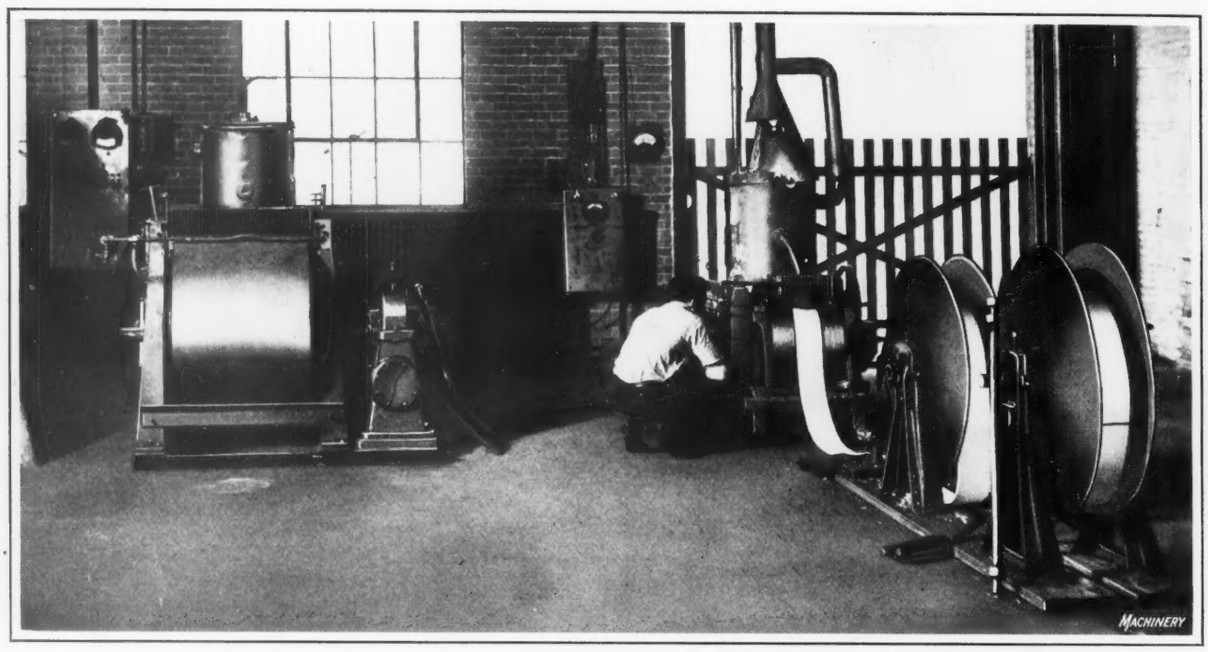


Fig. 1. Two Machines for casting Lead and Tin in Strips or Sheets Hundreds of Feet in Length at an Average Speed of 100 Feet per Minute

Casting Lead Alloys in Endless Strips

A Method Used in the Manufacture of Grids for Storage Batteries that is Applicable in Other Fields of Industry

CASTING antimony-lead alloys in continuous strips hundreds of feet in length, at an average speed of 100 lineal feet per minute, is accomplished at the plant of the Hazelett Storage Battery Co., Cleveland, Ohio, by means of a special machine designed to reduce costs in the manufacture of storage batteries. The grid stock is cast to No. 16 gage and to a width of about 6 inches, but satisfactory sheet has been produced from 1/64 to 1/8 inch in thickness and up to 24 inches in width. As the grid strip comes from the machine, it is coiled on large spools from which it is later fed to a power press to have the openings in the grids punched. The individual grids are not severed at this time, the stock remaining in one continuous strip until several other operations have been performed. The method of casting the lead strip is of especial interest, as it can be applied in the manufacture of other parts and for producing strips of other metal. For instance, tin, and (it is believed) aluminum, can also be cast by this method.

The Casting Process

Two of the casting machines are illustrated in Fig. 1, the one at the right being shown in operation, while the larger machine at the left is idle. Each equipment consists essentially of a melting furnace, a rotating drum or roller, and a bronze casting known as the "gate," which is composed of a series of vertical ribs or fins. This gate receives the molten metal from the furnace through a flexible hose and delivers it on the drum. In the illustration the gate is seen above the drum. On the machine at the right, the tube through which the metal flows to the gate is shown in place, but it has been removed from the idle equipment. It is highly essential that the gate be kept heated to a temperature greater than the melting point of the metal being cast, and that the drum be kept at a much lower temperature—about equal to the boiling point of water.

Then the metal remains in the molten condition while in the gate, but as it flows through a narrow slot at the rear of this casting and on the revolving drum, it becomes chilled at the bottom and solidifies entirely through, shortly after it leaves the front edge of the gate. The chilling gives the bottom a surface which is a counterpart of the drum surface in appearance, while the top receives a frosted finish, due to the front edge of the gate resting on the metal, and, being heated, acting somewhat as a soldering iron across the entire strip. As the strip leaves the machine, it is wound on one of the spools by a workman turning a crank.

The success of the operation depends to a large extent upon maintaining the correct relation between the temperatures of the gate and drum, and the rotation of the drum. For this reason there is a provision for rotating the drum slower when the metal becomes hotter, or faster when the metal becomes less hot. If the drum revolves too fast for the temperature of the metal, the strip will not have solidified sufficiently by the time it leaves the drum. The operation requires the close attention of one who can tell from the appearance of the metal when to speed up or slow down the drum and who will know when the temperature of either the gate or drum is too low to produce satisfactory results. In producing stock 0.10 inch thick, the drum has a speed of about 40 lineal feet per minute; in producing No. 16 gage stock, about 80 feet per minute; and in producing 1/64-inch stock, about 200 feet per minute.

Details of the Construction of the Machine

The temperature of the gate is maintained by a gas flame, directed across the entire row of fins at the front of the gate and also against a flat wall at the rear, and by the metal itself, which is heated in the furnace to a temperature about 200 degrees F. higher than the melting point. There is a series of ribs running from front to back in the gate between which the heated metal flows, and this also assists radiation. The metal is delivered to a sort of reservoir at the front and leaves through a slot at the back which is about ⅛ inch wide and of a length to suit the width of strip that the gate is intended to cast. A piece of sheet asbestos is placed between the gate and the drum in back of the slot to prevent the molten metal from running down the rear side of the drum. The gate is a bronze casting, because it

was found that when an iron casting was used, the lower surface would become cooled from the drum, as the radiation of cast iron is less than that of the material being worked. The gate casting actually touches the drum on the right- and left-hand sides where there are slight ribs and also on two very narrow edges which govern the width of the strip.

The temperature of the drum is kept at the boiling point of water by a unique method. The drum is a hollow iron casting into which water is admitted through a pipe that enters on the left side at the center of the shaft on which the drum is supported. There is a gas flame which plays against the bottom of the drum on the rear side to keep the water boiling. Obviously, the drum cannot become much hotter than the boiling point of water, because any heat that may be transmitted from the gate through the strip metal to the surface of the drum will be dissipated by the water. However, care must be taken to see that the drum does not become cold. The steam is exhausted through a pipe leading from the opposite side of the drum shaft. There is a groove or recess in the drum of a width and depth corresponding to the width and thickness of the strip to be cast, and the metal is delivered into this recess from the gate slot. Strips thicker than the depth of the groove may be obtained by placing shims of the necessary thickness between the gate and drum to raise the gate.

Power for driving the drum of the small machine is obtained from a five-horsepower variable-speed motor at the right, which cannot be seen because of the first spool. The motor drives through reduction gearing to the drum shaft. The melting furnace is a Blatchford gas furnace of the three-burner type, but an oil-burning furnace could be used as well. The diameter of the drum on the small machine is 17½ inches, and on the large machine 40 inches. A worm reduction gearing is incorporated in the large machine to obviate chatter.

Advantages of the Process

Although the main advantage of the process is a large saving of time in producing grids, it is also claimed that a higher quality of grid is obtained than when the material is rolled or cast under pressure. It is said that the metal has a finer crystalline structure of about double the tensile strength, greater hardness, and about fifty times as great a resistance to chemical corrosion at normal temperatures. Because of the latter property, the metal is suitable for use in lining acid tanks in which the temperature is not above 220 degrees F., at which point antimony in both cast and rolled stock becomes a disadvantage.

Thin stock can be as readily produced as thick stock. With this process, there are no blemishes in the metal surfaces, and the edges are almost as straight as if sheared. The large machine can produce stock at the rate of about 1 ton in 4½ minutes, and the length of strip depends entirely upon the capacity of the furnace. The cost of producing sheet lead by this means is very low. Labor is needed only for putting the ingot metal into the pot of the furnace, watching the operation of the machine, and disposing of the sheet as it comes from the machine; consequently, only one operator and a helper are required. The overhead expense is merely the cost of fuel for melting the ingots, power, and maintenance. The power cost is about 5 cents per ton, and the maintenance cost is equally small. A final advantage is that a very thin lead alloy strip with only 7 per cent antimony can be produced; whereas, in casting thin grids by the old method, from 10 to 12 per cent antimony was necessary to make the metal sufficiently fluid.

Final Steps in Making the Grids

As previously mentioned, the strip lead is fed from the spools on which it is coiled to a power press to have the openings or slots in the grids punched. This machine is shown at the left in Fig. 2, from which it may be clearly seen that the grids are not separated in the punching operation. They are fed in a continuous chain over a table where a workman forces red oxide of lead by hand into all the slots. Then the grids are passed between rollers, with paper above and below the grids, in order to compress the oxide in the slots.

One of the incidental advantages resulting from punching the grid slots rather than casting them is that the roughness of the slot edges serves to hold the oxide so well in place that, after the rolling process, it is necessary to bend

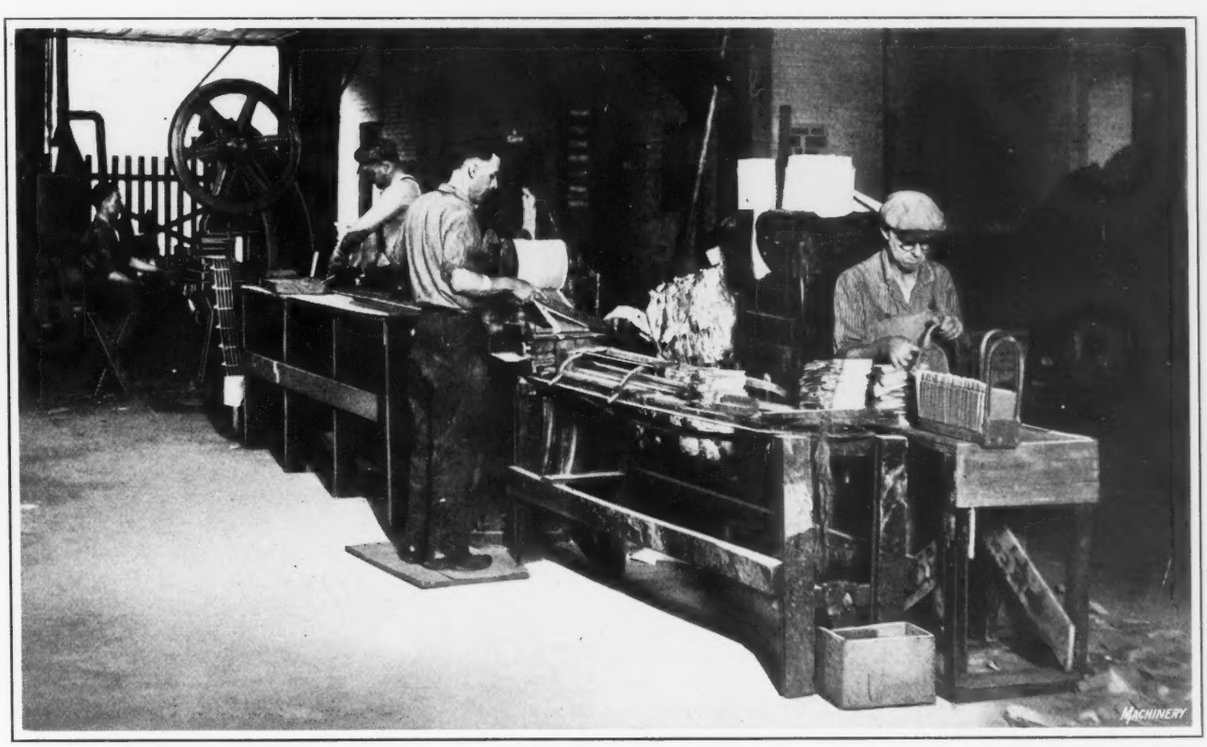


Fig. 2. Punching Storage-battery Grids in a Continuous Chain, filling with Lead Oxide, compressing, cutting to Length, and stacking for the Pickling Bath

the grids to a sharp angle in order to dislodge any of the oxide. As the strip of loaded grids comes from the rollers, the grids are cut to length by a workman using a knife hinged to the table. The grids then fall on a belt conveyor which carries them to the man in the immediate foreground, who removes the strips of paper from the sides and stacks the grids in trays ready for the pickling bath. The production of this group of workmen averages thirty-two grids per minute, and the saving in time effected by the entire method of making the grids, including the operation of casting the strip, is approximately 90 per cent over the older method in which the grids were cast individually.

Since the material for this article was obtained, automatic feed has been installed on the punch press, and a special press has been installed for cutting the plates apart.

* * *

TERMS RELATING TO HEAT-TREATING OPERATIONS

The recommendations and definitions given in the following have been tentatively approved by the Recommended Practice Committee of the American Society for Steel Treating.

During recent years, heat-treatments have become more and more complicated, and as a result there has arisen a certain confusion in regard to the meaning of commonly used terms. For instance, in one locality or trade, any operation of heating and cooling resulting in a softening of the material is called "annealing," whereas in other places to "anneal" means not primarily "to soften," but to heat above the "critical temperature" and to cool very slowly. Similar confusion as to the meaning and application exists in regard to other terms, and as a result, "annealing," "tempering," "normalizing," etc., are used by different people to mean widely different things.

In any attempt to define accurately the terms commonly used in connection with heat-treatment, the first question to decide and the most important one is: Do the terms relate to the heat-treatment operation itself or to the results obtained by the treatment? In other words, is the term indicative of the structure or the condition obtained, or of the operation performed? After careful consideration, it appears most logical and most in keeping with present-day usage to have the terms so defined that they shall mean definite operations and shall not be considered as referring to the structures or general conditions resulting, although, in the great majority of cases, the structures or conditions resulting may be quite similar.

At first glance, it would appear entirely unnecessary to coin any new words. It seems, however, that one of the reasons for the confusion that exists is the lack of adequate terms with which to express the different operations and conditions met with. In suggesting the use of the term "loneal," an attempt is made to relieve the term "anneal" of some of the misuse from which it suffers and to eliminate the term "draw" which has such wide application in regard to the mechanical operations performed on metals as distinct from thermal treatments.

In commercial practice, the terms here defined will vary slightly, depending upon the material under consideration. A "relatively slow rate of cooling" does not mean the same thing for an alloy steel as for a plain carbon steel, but the general meaning of the terms should remain the same, regardless of the material being treated. This must necessarily be the case if the term relates to the actual operation and not to the structure or the condition resulting from the operation. Heatings and coolings, during any part of which steel is worked mechanically, are excluded from the meanings of the terms here given.

By "heating," as appearing in the following list, is meant a thorough and uniform penetration of the heat. By "critical temperature" is meant that temperature which is customarily associated with the following phenomena: Hardening when quenched; loss of magnetism; absorption of heat; formation of solid solution; and pronounced refinement of coarse grain upon cooling.

The definitions proposed are as follows:

Annealing—Heating above the critical temperature, followed by a relatively slow rate of cooling.

Loneal—Heating below the critical temperature, followed by any rate of cooling.

Normalizing—Heating above the critical temperature, followed by an intermediate rate of cooling. (Note: In good practice, the heating is considerably above the critical temperature).

Spheroidizing—A long-time heating at or about the critical temperature, followed by slow cooling throughout the upper part of the cooling range. (Note: For the purpose of spheroidizing the cementite in high-carbon steels).

Hardening—Heating above the critical temperature, followed by a relatively rapid rate of cooling.

Tempering—Reheating after hardening, to some temperature below the critical temperature, followed by any rate of cooling.

Carburizing—Adding carbon, with or without other hardening elements such as nitrogen, to wrought iron or steel by heating the metal below its melting point in contact with carbonaceous material.

Casehardening—Carburizing the surface portion of an object and subsequently hardening by suitable heat-treatment.

Cyaniding—A specific application of carburizing where the object, or a portion of it, is heated and brought into contact with cyanide salt.

Comments on these definitions are requested and should be sent to J. Edward Donnellan, 4600 Prospect Ave., Cleveland, Ohio.

* * *

THE STRAINMETER

An interesting mechanical appliance known as the "strainmeter," made by the Foster Instrument Co., Letchworth, England, is described in a recent number of *Engineering*. The stresses to which composite steel structures are subjected can only be determined by observations with suitable instruments on the actual erections. In such actions as launching a ship or running it at sea, in accelerating or stopping the load on a crane, changes in stress occur which may produce considerable strains. The measurement of these strains is of great importance in obtaining an estimate of the suitability of the customary design. The strainmeter has been designed to furnish, for the measurements, a simple instrument, easy of adjustment and operation, to facilitate investigation of strain actions in these and similar cases. With it the strains are measured by the change of the volume of fluid necessary to fill a diaphragm box, which is supported on one part of the structure and the diaphragm of which is pressed by movement transmitted from a point further along the structure. To obtain an open scale for the measurements, the change in volume is measured with a gage glass of narrow bore.

* * *

WAGES IN DIFFERENT COUNTRIES

A comparison between wages paid in different countries is made in a recent number of the *Nation's Business*. It is, of course, difficult with the present depreciated currency in many countries to make direct comparisons, but the figures given in the following are based upon a study made by the British Ministry of Labor on the basis of the amount of food that can be purchased with the wages paid in certain occupations in the cities mentioned. The standard of comparison is London, for which the index number is 100. Compared with London, wages paid in New York are 217; Ottawa, 180; Amsterdam, 103; Christiana, 92; Stockholm, 87; Warsaw, 85; Brussels, 70; Paris, 68; Prague, 67; Madrid, 61; Berlin, 57; and Vienna, 55.

FINISHING PISTON-RING GROOVES

The Research Department of the Society of Automotive Engineers was requested some time ago to furnish information on various methods used for finishing the grooves in piston-rings to a high degree of polish and accuracy. This inquiry led to an investigation, the results of which are published in a recent number of the Journal of the Society of Automotive Engineers, from which the following information is abstracted. The practice recorded is that of leading manufacturers, and should prove of interest and value, not only to those engaged in piston-ring manufacture but also to men interested generally in mechanical processes and methods.

Attention is called to the fact that finishing with an ordinary forming tool leaves a series of tool marks or ridges that wear away very rapidly, thus creating a leakage space around the rings. Grinding and lapping processes, while they would produce the required results, are considered too expensive for general production purposes in this particular instance. One manufacturer, who finds it possible to finish the grooves with cutting tools in a satisfactory manner, describes his methods as follows:

"In our regular production we use the customary method of machining the grooves in the pistons, but to hold the grooves to size and get as smooth a finish as possible on the sides, we make a roughing and a finishing tool. By properly shaping the tool on the finishing cut, we are able to secure a fairly smooth surface on the sides of the grooves. We also take considerable pains to keep the piston from moving endwise ever so slightly during this operation, as this produces wavy grooves and causes loss of power and leakage of oil.

"Some time ago we installed in an engine two pistons with the grooves very accurately tooled and polished. The remaining two pistons were of our standard production. We ran several tests to determine the ability of the two types of piston to hold compression, but were unable to ascertain whether or not the pistons with the polished grooves were superior to the others in this respect."

The forming tool is also found satisfactory by another automobile builder who writes:

"We find that an ordinary forming tool, when properly ground, is very satisfactory for this purpose. Some of the essential details are proper hardness of the tool, proper setting, point clearance, feed and speed, and the condition of the piston iron. When these conditions are met, a smooth and true groove should be the result."

One promising method offered for finishing grooves involves burnishing or rolling operations. A prominent company writes:

"The groove is first roughed out with a solid tool to approximately full depth and 1/8 inch wide. Then a second cut is taken on another machine, which deepens the groove slightly and widens it to 5/32 inch. This we hold to a tolerance of 0.010 inch.

"On the same machine, using the back cross-slide, the third cut is taken with split tools that do not cut at the bottom of the groove at all but simply shave the sides to a limit of from 0.1868 to 0.1878 inch; at least these are our gage limits, but the piston grooves are actually made much closer than this.

"The fourth operation on the grooves is on a lathe where we run in a revolving burnishing disk that has sharp edges and is 0.1873 inch wide. This burnishes the sides of the groove and removes any ridges that might be left by the finishing tool. The final operation on the grooves consists of burring the corners and polishing the bottom with a narrow strip of emery cloth.

"In our opinion this method is as good as any unless we wish to go to a very expensive lapping operation. We believe also that the chief cause of wear between the ring and the groove is the roughness of the ring itself on the side. These rings are very hard and they are usually rather rough on the side from improper grinding and there is a filing action between the ring and the groove due to the fact that the ring is so much harder than the piston.

"It is now possible to lap the rings on the sides very economically and accurately, and we are considering doing this, as we will secure a flat, smooth, accurate ring that would certainly contribute greatly to longer wear."

A second company writes:

"The method followed in our factory for finishing piston-ring grooves is to burnish with hardened, ground, and lapped high-speed steel rollers running in oil, set on a shaft in a holding fixture and used in a lathe. The rollers have a lateral movement to compensate for variation between grooves. The width of the rollers is about 0.0003 inch greater than the maximum width of the groove gage. The proper width of the rollers is controlled by the grade of cast iron in the pistons. The operation is short and is very satisfactory."

A third company states:

"So far our best results have been obtained with a burnishing roll or disk of approximately the same diameter as the piston, mounted on ball bearings and attached to the cross-slide of a lathe, burnishing one groove at a time. We are now equipping to try a combined skiving and burnishing operation."

Another factory uses a tool-holder carrying a series of hardened steel disks of the correct thickness, properly spaced to fit the piston-ring grooves. These disks burnish the metal on each side of the groove and have apparently proved successful.

A motorcycle manufacturer reports as follows:

"We have done a great amount of experimenting in this direction, using a finishing roll about 5 inches in diameter made of carbon steel, ground and lapped to the proper width, and ground to produce very sharp corners. We found the roller would not work with round corners. This roll was mounted on a stiff bearing, which permitted it to float sidewise so that it could line up with the groove. The piston, made of cast iron, was held in a fixture in a screw machine, with the roller on the cross-slide. From 0.0005 to 0.0020 inch was left in the width of the groove for the roller to reduce to size. The roller was fed into the groove to the proper depth; with 0.0005 inch over-size stock, the roll action was a smoothing operation, and with 0.0020 inch over-size stock, a cutaway one, but in both cases the finish produced was smooth and compact on both sides of the groove. We found that straight carbon tool-steel rolls wore away and lost their size rather quickly, and we changed over to S. A. E. 3120 chrome-nickel steel, carbonized and hardened, which we found will outwear tool steel in an operation of this kind. We believe that good results can also be obtained by using regular chrome ball-steel."

A plant that has not found success with the methods described in the foregoing writes:

"We have done some experimental work in an attempt to improve our present method of finishing these grooves, principally with highly polished rolling tools, and thus far have not been successful in improving at all on the method that we have always used. This method consists of making two cuts in the ring grooves, the first cut roughing them very close to size, and the second taking a very fine finishing cut with a reasonably slow feed."

* * *

The Patent Office, in its report for 1923, records a gain at the rate of 1000 per month in acting upon applications for patents, designs, and trademarks. This has been made possible by its increased personnel and the reorganization of the work. However, there are still on hand 67,000 patent cases, 900 design cases, and 2100 trademark cases awaiting action. It is stated that even working at the present rate, it will take five years to reach current work with the present force.

Interlocking Devices

Third of Three Articles Describing Different Types of Interlocking Devices

By ALBERT CLEGG

IN the two preceding articles which appeared in February and March MACHINERY, respectively, various types of interlocking devices designed to meet the usual requirements of lathes and other machine tools were described. In the present article a description is given of a more complicated system of interlocking, as exemplified in the design of a six-speed, all-geared drive machine tool.

Interlocking Device for a Geared Drive

In the example to be considered the transmission consists of nine gears and three shafts. The drive is from a pair of tight and loose pulleys. The speed of the pulleys is about 500 revolutions per minute, and it is this comparatively high speed that makes it necessary that all the speed-changing levers be interlocking, so as to minimize the risk of damage by preventing the engagement of the gears while under load. The correct relative location of the shafts is shown in the end view, Fig. 9. The plan view merely shows the three sets of gears as if they were all in the same plane. At *A* is the pulley shaft which carries twin gears having an axial movement that permits them to be engaged with either of two gears on shaft *B*. The latter is an eccentric shaft carrying four gears, all of which are fixed together, but run loose (as a whole) on the shaft. Shaft *C* carries three gears which may be engaged at will with the three mating gears on shaft *B*.

The gears on shaft *B* give three speeds, which are doubled by the twin gears on shaft *A*, thus giving six speeds in all. It might be mentioned, at the outset, that this design of gear-box is not presented as an ideal one, as there are several features that are open to criticism, but, apart from other considerations, it is an excellent example of interlocking, and it is only with this point that we are immediately concerned. The eccentric shaft *B* is really the foundation of the whole system. This shaft is controlled by a lever *D*, fitted with a spring plunger which holds it in the vertical position. Slightly more than a 90-degree angular movement is required to bring the lever into the position indicated at *E*, which causes the gears on the eccentric shaft to be thrown entirely out of mesh both with the gears on shaft *A* and with those on shaft *C*.

Referring now to shaft *A*, the larger of the two gears carried by this shaft has a washer *O* secured to it, which is of a diameter equal to the external diameter of the gear itself. This washer must lie either on the right or on the left of gear *N*; that is, it cannot be located anywhere in the width of face of gear *N*, because it would interfere with the teeth. The washer *O* thus insures that either the gears *R* and *S* or *P* and *N* are in mesh. Were there no washer, it would be possible for the twin gears *R* and *P* to be in a mid-position, with two pairs of different ratio gears in mesh at the same time. Of course, this trouble could be obviated by increasing the distance between the gears, but such a course would affect the interlocking properties of the design as originally conceived. The washers *M* and *L* on the largest of the three gears on shaft *C* serve a similar purpose to washer *O*. These washers prevent the half and half engagement of the gears, and necessitate that the eccentric shaft be thrown into the out-of-mesh position before the sliding gears can be shifted. It is really the object of

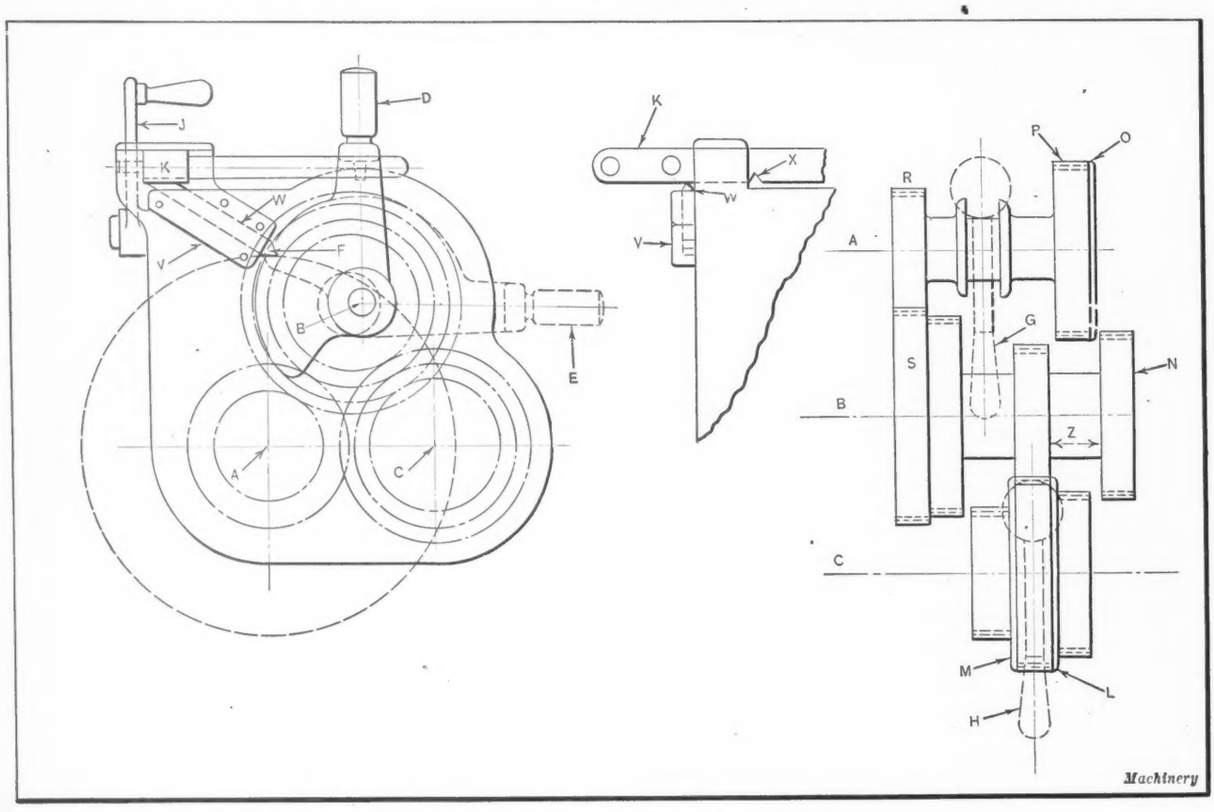


Fig. 9. Gear-box Drive with All Controls interlocked

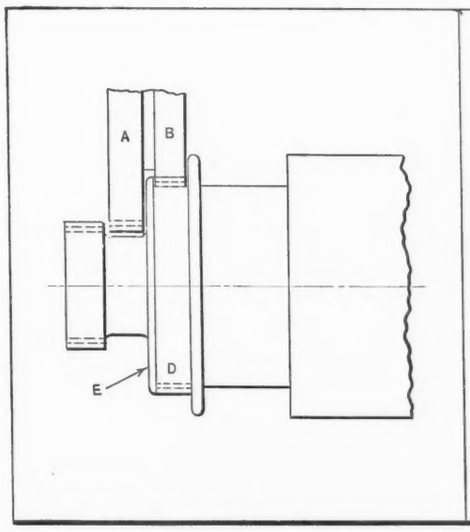


Fig. 10. Interlocking Device for Double Back-gears

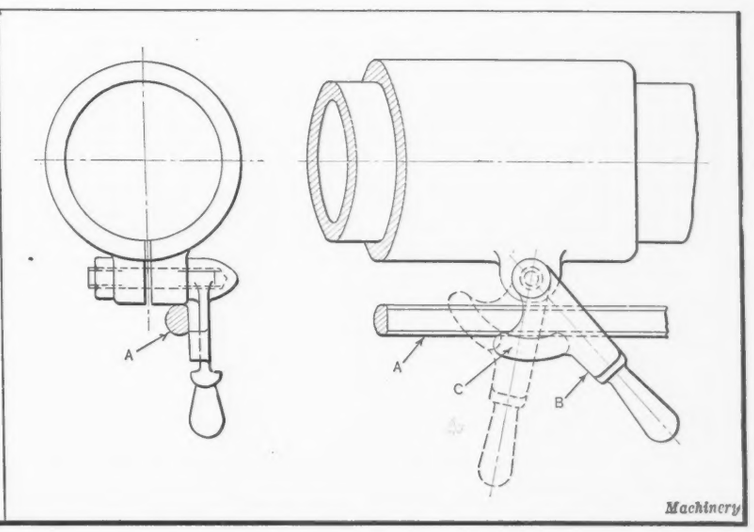


Fig. 11. Interlocking Device for Power Elevating Mechanism

the washers to insure that the eccentric-shaft gears are disconnected before a change of speed is made.

The next step is the connecting of the eccentric shaft to the belt-shifting gear, and this is provided for quite simply. The belt forks are mounted in a fairly substantial belt bar *K*, which is moved by the lever *J*. On the end of the gear-box is bolted a short slide *V* provided with a plunger *W* which has pointed ends. The lower end enters a V-shaped groove *F* in the eccentric-shaft lever, and the plunger is held down against the lever by gravity. In the belt bar *K*, is another V-shaped groove which receives the opposite end of the plunger.

When the belt is on the fast pulley; the belt bar is in its extreme right-hand position, and the V-groove *X* is out of line with the plunger, the plunger end coming snugly up against the body of the bar. In this position, the eccentric-shaft lever is locked by the plunger and is engaged with groove *F* in the quadrant of the lever. Since none of the sliding gears can be moved (because of the washers previously referred to) until the lever has been swung to position *E*, it follows that no change of speed can be made until the belt is first shipped on the pulley and the power thus shut off. Further, when the belt bar is moved to the left until groove *X* is opposite the upper end of the plunger —the belt then, of course, being on the loose pulley—the act of swinging down the eccentric-shaft lever raises the plunger into groove *X*, thus locking the belt on the loose pulley until the eccentric shaft is again returned to its "in-gear" position.

With the lever in position *E*, the two sets of sliding gears may be manipulated as occasion requires, and when the desired change has been made, the gears are again engaged by returning the lever to its original position, after which the belt is shipped to the fast pulley. If the sliding gears are not correctly positioned sidewise, the washers *O*, *M*, or *L*, by interfering with their respective gears, will not allow the eccentric shaft to go fully back into its normal "in-gear" position, so that, here again, the operator has little chance to blunder.

To alter the speed, the sequence of movements is as follows: (1) Move the driving belt on the loose pulley; (2) swing down the eccentric-shaft lever; (3) move the two sets of sliding gears to the required positions by means of levers *G* and *H;* (4) swing back the eccentric-shaft lever; and (5) ship the belt on the fast pulley. The interlocking arrangements insure that this sequence is always followed, and though it may sound a little complicated and involved, it is much more quickly done than described, and the arrangement certainly removes practically all risk of injury to the gears.

Regarding the introduction of an eccentric shaft, there may be some difference of opinion as to the efficacy of this arrangement. It is open to the objection that it tends to slow down the operation of the machine, because of the necessity for allowing the machine to come to rest before the eccentric shaft can be safely swung back into the "in-gear" position. When ordinary sliding gears are used, the power is first shut off, the necessary speed changes made, and the belt reshipped, before the machine has fairly come to rest, thus saving a certain amount of time. On the other hand, there is one advantage to be derived from the use of the eccentric shaft, and that is the fact that double helical gears can be used for the driving gears, if desired. If this is done, the drive will be much smoother and less noisy—two features of importance when the speeds are so high.

Another advantage of the eccentric shaft is that it reduces the over-all length of the gear-box, because it does away with the necessity of having a space of two face-widths between the gears, as at *Z*. With ordinary sliding gears, this distance would have to be slightly greater than twice the face width of the gear so as to allow one gear to slide out of engagement before the other entered. By swinging the gears out of mesh, as is done by the eccentric shaft, the distance *Z* between the fixed gears is reduced to slightly over half, thus giving greater compactness.

Interlocking Arrangement for Back-gears

Another application of the washer or shroud idea is illustrated in Fig. 10, which shows a simple device by means of which the double back-gears of a lathe or other machine are prevented from being engaged so as to cause damage. As ordinarily made, there is nothing to prevent double back-gears from being engaged with both pairs of teeth in mesh, in which case serious damage would probably result. If, however, the gears are arranged as shown in Fig. 10, with a washer, or shroud, equal to the external diameter secured to the larger cone gear *D*, there is not the slightest possibility of the gears being otherwise than correctly engaged. In some cases the two sliding gears *A* and *B* on the quill are not provided with washers and are pushed across from one position to the other by hand, so that should they happen to stick in some intermediate position, both pairs of gears would be engaged at once if the eccentric gear-meshing shaft were manipulated.

With the arrangement shown, the gears must be correctly located sidewise; if they are not, the washer *E* will prevent their engagement by coming in contact with the top of the teeth of sliding gear *B*. Incidentally, it might be mentioned that double helical gears in this connection would do away with the necessity for any interfering device

whatever, as the V-shaped teeth would prevent any axial movement unless the gears were first thrown out of mesh.

Interlocking Device for Elevating Mechanism

Power elevating mechanisms, of which there are many examples in machine tool practice, should be equipped with some form of interlocking device which would insure that the parts to be elevated are unclamped before the power is applied. Without some such provision, there is every possibility of the operator blundering sooner or later, and having a more or less serious smash-up. The arrangement illustrated in Fig. 11 is designed to prevent such accidents. The shaft *A*, which by partial rotation controls the elevating gears, has a wide flat on one side, while the clamping lever *B* has a fan-shaped projection *C* which, when the lever is in the upper position, fits snugly against the flat of the shaft and thus prevents the shaft from being rotated. When the lever is in this position, the parts are clamped, and the elevating gears are locked out of engagement. When the lever is pulled into the lower position (as shown by the full lines), the parts to be elevated are unclamped, the tail of the lever moves clear of shaft *A*, and the elevating gears may then be engaged as required, in the certainty that everything is in order and that there is no risk of breakage.

In some cases a different method from the one just described is followed. Somewhere in the elevating mechanism—usually in the connection between the elevating screw and its driving gear—a slipping device is fitted, this device being so adjusted that it is quite capable of performing its normal duty; but should there be any accidental over-running, or should the operator have forgotten to unclamp, or any other abnormal circumstances arise which unduly increase the load, there would be a slippage and not a breakage, thus saving the machine from serious damage and breakdown.

* * *

REWARDING INITIATIVE

What appears to be a new method of giving recognition to the constructive work of employes in American industry was recently put into effect by the General Electric Co., Schenectady, N. Y. At the various plants of the company, some of the employes were publicly called forward by the works manager in the presence of their fellow employes and presented with an award of money and a certificate acknowledging their contribution to the progress and development of the industry. These awards, comparable to the honors conferred upon engineers by engineering societies, were made from the Charles A. Coffin Foundation, named in honor of the founder of the company. So far as is known, this is the first time that the workers in the shop have been publicly recognized for work they have done for the industry outside of their ordinary duties. Engineers and research workers have gained public distinction by their achievements, but the man in the shop has seldom become known to other than a few of his immediate associates for work that has sometimes had an almost revolutionary effect on the branch of the industry in which he is engaged.

One of the improvements, for example, referred to the tipless Mazda lamp which is now coming into general use. The problem of how to remove the sharp tip, which has always been an objectionable feature of the electric lamp, has puzzled engineers for many years. Two foremen in the National Lamp Works—Louis E. Mitchell and A. J. White—both young men, turned their attention to it and found a solution. It is for achievements of this kind that the recognition referred to above is given. Altogether one woman and forty-seven men received awards.

* * *

It is stated in a Commerce Report that there was an increase of $9,000,000 in the value of the exports from the United States of electrical machinery, apparatus, and supplies during 1923, as compared with 1922.

HARDENING DIES IN AN ACID BATH

By G. R. CASTER

The method of quenching dies in an acid bath, as described in this article, is, as far as the writer knows, employed in only two plants. In these plants it has proved very successful, and there is no reason why it cannot be used to advantage in other plants, especially in cases where no pyrometers are employed, and the heat-treating equipment is rather limited.

Some time ago the writer was employed as diemaker in a factory manufacturing cooking utensils. The plant was a new one, and had not then been provided with a heat-treating department. However, arrangements had been made with an adjoining factory for performing hardening operations in their plant. The first time a die was taken to this plant to be hardened, the foreman inquired whether brine or acid was to be used as a quenching bath. Never having heard of using acid as a quenching bath, the writer inquired about the process and was told that sulphuric acid, such as is commonly used in pickling steel, was employed. This acid was not diluted but used just as it came from the chemical works. The writer who has had quite an extensive experience in diemaking, was rather skeptical as to the results obtainable with the acid quenching bath. The hardened die, however, came out of the bath light gray in color and free from scale. On testing with a file it was found to be dead hard. The die was drawn after quenching, and after assembling and grinding was put into service.

The particular die referred to is used for piercing and blanking a part of an aluminum utensil known as an ear. This die produced the part at one stroke of the press from 16-gage steel. The stock was annealed but not pickled. About 185,000 pieces were blanked and pierced before it became necessary to regrind the dies. This equalled the best record previously made and proved that the hardening qualities of the acid bath were satisfactory for this class of work.

A number of dies with very thin sections were also hardened in the acid bath without experiencing any trouble from hardening strains or breakage. The writer finally constructed an acid hardening bath by packing a twenty-gallon stone jar inside of a barrel, using sand to fill in the space between the jar and the barrel. About fifteen gallons of acid were put in the jar. The material used for the dies that were hardened in the acid bath was a good grade of water-hardening carbon steel. The principal advantage gained by using acid as a quenching bath is that warping and breakage are overcome. In addition, tools hardened in this way give exceptionally good service. It should be borne in mind that the fumes of the acid are poisonous and that care must be taken not to inhale them.

* * *

TESTING STEEL BY MAGNETIC ANALYSIS

It is now possible, through a recent development in the application of magnetic analysis to the testing of steel, to distinguish between proper and improper heat-treatment magnetically. Several interesting demonstrations of apparatus designed for this purpose were recently made at the laboratory of the Burrows Magnetic Equipment Corporation in Jersey City, N. J. In one of these, rods of chrome-molybdenum steel which had been quenched at a certain temperature and then drawn at lower temperatures, 50 degrees apart, were tested, and the apparatus clearly indicated the differences caused by the variations in temperature. Another test was made on a number of saw blade blanks, and in this case also the effects of too high or too low temperatures in heat-treating were evident. Apparatus for determining depth of case and heat-treatment of pinions for automobiles was demonstrated. An interesting feature of this test was that both the depth of the case and the reliability of the heat-treatment were determined by the same mechanism.

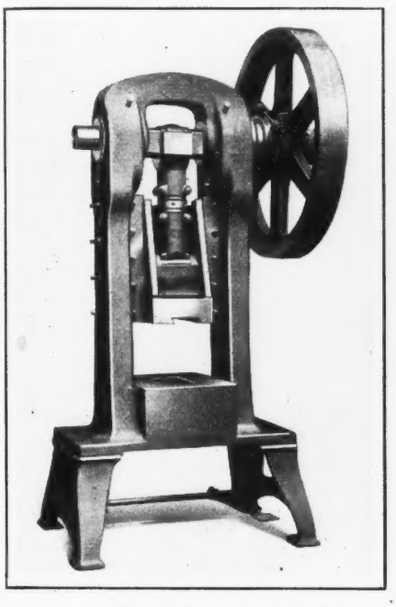


Fig. 1. Straight Upright Pillar Press

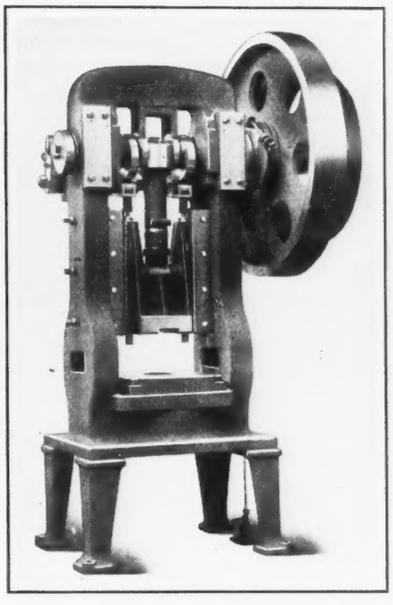


Fig. 2. Open-side Press

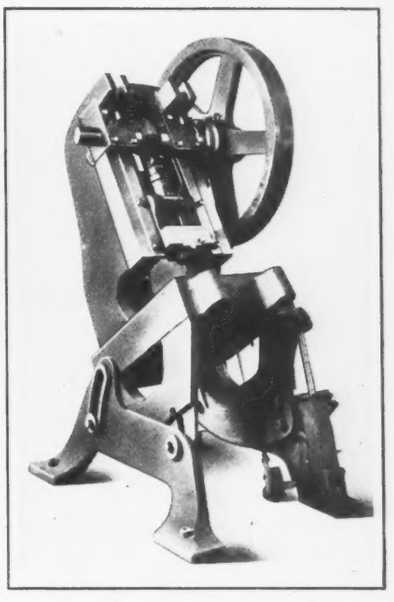


Fig. 3. Open-back Inclinable Press

Classification of Power Presses

By FRED R. DANIELS, The Waterbury Farrel Foundry & Machine Co., Waterbury, Conn.

LITTLE attempt has been made in technical literature to differentiate between the various types of power presses. A power press is generally just a power press. As a matter of fact, there are a great many classes of power presses, as well as a number of means of designating each class. One method of denoting the style is by its use, as for instance, blanking, drawing, or embossing. Another method of classifying presses is by the means of actuating the slide or gate, as crank, cam, or toggle. Still another method of classifying, and perhaps the most preferable one, is by the style of the frame. In this article the latter method is advocated, because the use to which a press may be put and the method of moving the gate may be varied. On the other hand, the style of frame is a natural and distinct method of classification. The names given in the following are those applied by the Waterbury Farrel Foundry & Machine Co. to machines built by this company, a few of which are illustrated.

Perhaps the oldest and simplest type of power press is the straight upright machine in which the bed and frame are one casting which has vertical sides, pillars, or uprights, as shown in Fig. 1. Machines of this type are intended primarily for blanking and punching, the stock being fed from front to back, or vice versa. Roll-, dial- and grip-feeding attachments, knock-out mechanisms, ejectors, and other appliances can readily be built into or attached to this type of press.

Open-side and Open-back Presses

Feeding attachments are often located at the back or front of the press, but perhaps the best location is at the side, where the operation of the machine is not interfered with. A natural development due to the application of feeding attachments at the side of the pillar press was the open-side press illustrated in Fig. 2, which is a straight upright ma-

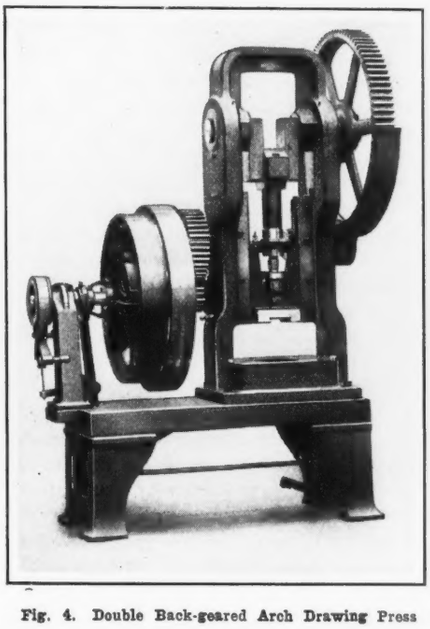


Fig. 4. Double Back-geared Arch Drawing Press

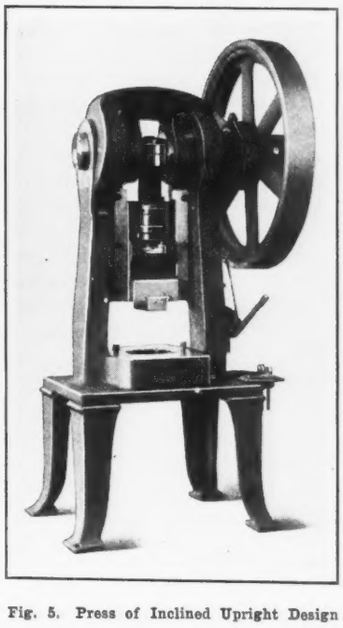


Fig. 5. Press of Inclined Upright Design

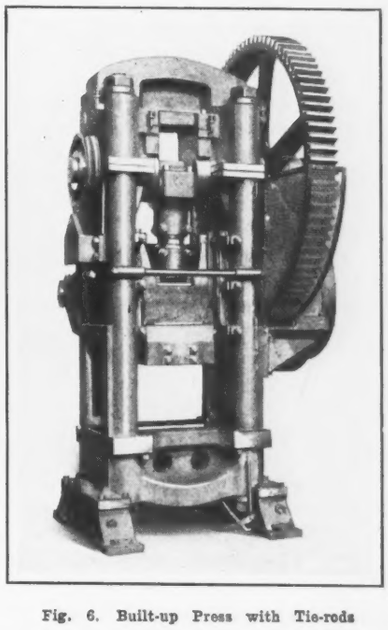


Fig. 6. Built-up Press with Tie-rods

chine having a hole at the desired height in both uprights to allow the stock to be fed through. It is necessary, of course, in this design to widen the sides to compensate for the metal removed in coring these holes, but otherwise the press is the same as the original straight upright machine. The machine shown in the illustration is equipped with a cam-operated stripper.

The advantages of this design for simple press work in which a feeding attachment is used, led to the development of the open-back press, which has the sides cast integral with the bed, being joined to it back of the bed center and extending up and to the front to provide for locating the slide or gate over the center of the bed. By this means a gap is produced which allows stock of a greater width to be fed from side to side than is possible with the open-side press. An open-back press with the inclinable feature is shown in Fig. 3.

Arch Presses—Inclined Upright Presses

Another development of the straight upright press, brought about, no doubt, by the need for wider tool space, is the arch-frame press. This machine is now rarely used for blanking and piercing operations, but is useful for redrawing deep shells. The arch press has the frame cast with wider beds than the nominal width, the uprights extending vertically for a short distance at the sides, then curving in toward each other to the width of the gate and, finally extending vertically again. The design is not especially good where severe strain and shock is encountered, and for that reason the arch press finds its principal application in redrawing work. The design lends itself readily to providing a long stroke, which sometimes is as much as 20 inches or more. Fig. 4 shows a double back-geared arch press equipped with a friction-clutch pulley and brake.

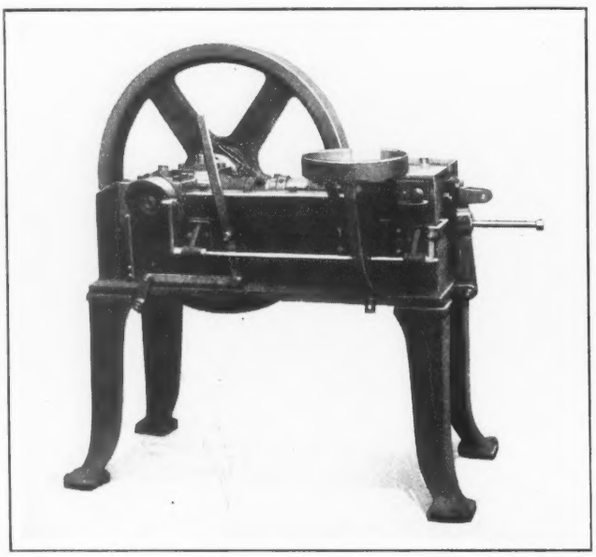


Fig. 7. Horizontal Pillar Press for Redrawing, Reducing and Tapering Operations

For the sake of providing greater tool space width, however, the inclined upright pillar press shown in Fig. 5 is no doubt preferable to the arch press, principally because of the greater strength per square inch of pillar section. The arch-frame sides are weaker due to the offset, which results in an eccentric load. The sides of an inclined upright pillar press lean toward each other from the bed to the crankshaft bearings, which gives a rigid support for the crankshaft so that there is, combined with the increased tool-space width, a more powerful crank motion. This machine is well suited for the application of attachments, and is generally selected for work requiring special rigidity, such as heavy blanking, punching, and forming. The inclined upright press is also made with holes cast in the sides to permit feeding the stock from side to side.

Built-up Pillar and Inclinable Presses

Pillar presses are also made with built-up instead of solid frames. This construction has certain advantages, chief among which is the fact that in case of breakage an entirely new frame is not necessary. The two sides, top span, and bed are separate castings as illustrated in Fig. 6, carefully fitted and fastened together by ordinary bolts or by shrunk-in tie-rods. The tie-rod construction has another advantage —that is, the frame can be made lighter than a solid cast-iron frame without sacrificing strength; in fact, it is claimed that steel tie-rods make the frame more rigid than a solid casting. Four tie-rods are used, one at each corner of the machine. Openings through the sides are usually provided, but the construction is strong enough so that it is not necessary to thicken the side castings to compensate for these openings.

Either the straight upright pillar press, the open-back press, or the inclined upright design may be arranged to be tipped back or inclined on their legs, as shown in Fig. 3, so as to allow the work to gravitate from the die. The inclinable press is one of the most useful machines for all-around purposes, since it can be used either vertically or at a convenient angle.

Horizontal Pillar Presses

Pillar presses are sometimes arranged horizontally on legs, as shown in Fig. 7. The principal use for this design is in redrawing, reducing, and tapering shells, where the nature of the operation is such that the work can be knocked out and will fall free of the die. The horizontal pillar press is also built with increased space between the die and punch, to accommodate sub-press tools. For this service, the machine is specially suitable, since the blanks can fall from the die without piling up on it (as sometimes occurs when sub-presses are used in a vertical machine), and damaging the tools. The horizontal pillar press, when arranged for sub-press work, is often provided with a stock reel, and a roll feed located over the die space, from which the stock is carried down through the dies and on a scrap reel beneath.

Classification by Method of Actuating Gate

The term "crank press" is not a classification according to a general type of frame, but rather to the method of actuating the gate. The gate may be actuated by a crankshaft on any press here mentioned except when the press is intended for such work as heavy drawing or for operations where sustained pressure is required at the end of the working stroke. For the first-mentioned use—that is, heavy drawing—a double-acting toggle mechanism is employed; while for the second use, the knuckle-joint press is the best. Knuckle-joint presses are almost always used for embossing, and are sometimes referred to as coining presses. Then there is the cam press, in which the slide is actuated by one or more cams. These machines are usually arranged for double-action work, such as blanking and drawing. Any of these gate-actuating means may be applied to the pillar press with straight, arched, or inclined uprights; to open-back presses; or to inclinable presses regardless of the design of the frame.

The rack-and-pinion press is another classification according to gate movement. This press is usually fitted with the familiar belt-shifting mechanism incorporated in planers, for reversing the movement of the gate. It is used for redrawing long shells that require a longer stroke than is recommended for an arch press equipped with a crank-actuated gate. For heavier drawing work on deep shells, the toggle press can usually be furnished with a sufficiently long stroke. The advantages of a rack-and-pinion press are that it furnishes a uniform speed for the gate during its entire stroke, provides a means of increasing the speed of the upward or idle stroke, and can be adjusted readily to vary the length of stroke.

Thrust Bearings of Pad Construction

By F. JOHNSTONE-TAYLOR, Lymm, Cheshire, England

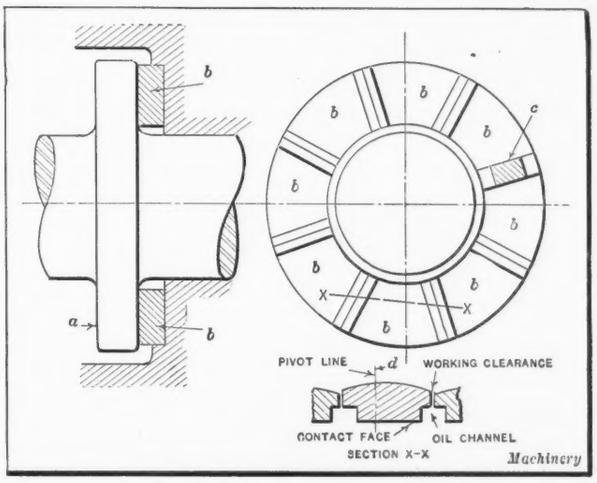


Fig. 1. Thrust Bearing of Pad Construction

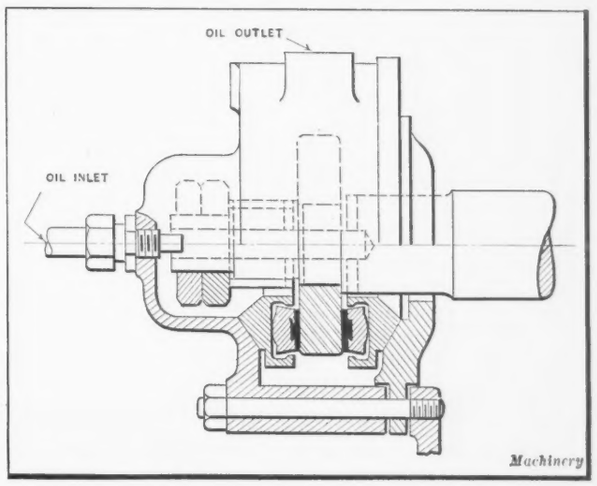


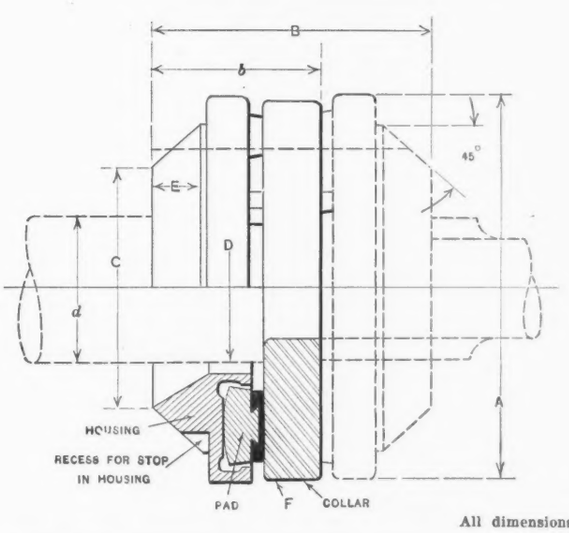
Fig. 2. Application of Pad Thrust Bearing to End of Shaft

THRUST bearings of the pad type described in this article are easily applied to shafts from 1 inch up to 6 inches in diameter, and when properly designed and constructed are capable of carrying heavy loads at high speeds. They can be housed in a comparatively small space, and have proved very efficient for taking the thrust loads of marine engines, turbines, etc. While the plain collar thrust bearing has given quite satisfactory results on slow-running machinery where the thrust loads are comparatively light, it is not satisfactory when heavy thrusts and extremely high speeds are encountered. The ball thrust bearing has gone a long way toward providing a simple and efficient means of dealing with end thrusts in cases where the loads and the speeds are moderate. The carrying capacity of the ball bearing, however, diminishes rapidly as the speed increases, and at comparatively high speeds centrifugal force becomes one of the limiting factors in the application of ball thrust bearings.

A collar thrust bearing of the plain type consists of one or more collars on the shaft which bear against stationary collars in a housing or bearing block. A film of oil, usually introduced under pressure serves, or rather is intended to serve, as a means of keeping the thrust collars on the shaft from actually making contact with the stationary collars. Application of the pad system involves replacing the solid stationary collar with a series of pads which, in effect, forms a collar composed of segments or sections. Each pad, although it appears to bear flat against the revolving collar, is, by reason of its construction, actually inclined to it at a very slight angle.

This inclination of the wearing or thrust surfaces is the important feature of the pad system, and is the practical method of applying the "tapered film law of lubrication," as originally outlined by Osborne Reynolds of Manchester, England, about thirty years ago. The theory involves very abstruse mathematics, but, in effect, it tends to prove that there cannot be efficient lubrication between two parallel faces subjected to a thrust load. The oil film is simply forced to break down between the parallel surfaces under this condition. The pads used in the thrust bear-

TABLE 1. DIMENSIONS FOR HORIZONTAL THRUST WASHERS



All dimensions in inches

Diam. of Shaft	Size of Bearing	A	For Double Thrust	For Single Thrust	C	E	Load, in Pounds
d	D		B	b			
1	1 1/4	2 7/8	1 3/4	1 1/16	1 3/4	5/16	750
1 1/4	1 1/2	3 3/8	2 3/16	1 5/16	2	7/16	1200
1 1/2	1 3/4	4	2 5/8	1 9/16	2 7/16	7/16	1875
1 3/4	2	4 1/2	2 15/16	1 3/4	2 3/4	1/2	2100
2	2 1/4	5 1/8	3 1/4	1 15/16	3 1/8	9/16	2700
2 1/4	2 1/2	5 3/4	3 9/16	2 1/8	3 1/2	5/8	3600
2 1/2	3	6 7/8	4 3/8	2 5/8	4 3/16	3/4	5400
3	3 1/2	8	5 1/4	3 1/8	4 7/8	7/8	6100
3 1/2	4	9	5 3/4	3 7/16	5 1/2	1	8400

Machinery

ings made by one English manufacturing concern are so constructed that they are able to take a position at an angle to the revolving collar, and thus permit of the existence, in practice, of the tapered oil film which is the vital point in the pad system as it is applied to thrust collars or thrust bearings.

Construction of Pad Thrust Collars

Referring to Fig. 1, *a* is a single thrust collar which may either be machined solid on the shaft or keyed to it. The thrust pads *b* which receive the thrust from collar *a* are assembled in a recess in a stationary housing. They are pivoted along radial lines *d*, as indicated in the sectional view *X–X*. These radial lines pass as near as it is possible to have them through the point of the resultant pressure, which is a little beyond the geometrical center of each pad. The pad is backed off in both directions from the pivoting line, but it need only be backed off in one direction if the shaft always revolves in one direction. This backing off will be toward the entrance edge so that the entrance of the oil will be unrestricted. By this construction each of the pads is permitted to assume the exact angle of inclination in relation to the revolving collar that the conditions of the load require.

Stop *c* prevents the rotation of the pads, which abut one against the other and are assembled in their recess with considerable end clearance, there being deep oil channels at the juncture of each pair of pads. The angle of inclination of a pad relative to the collar varies slightly under different loads and speeds, and also with a variation in the viscosity of the oil, but the pads will take up the correct angle at any time and under any conditions, as previously mentioned.

The Pad System Applied to Thrust Washers

The construction of the thrust washer shown in the view at the head of Table 1 should be quite clear. The single collar *F* revolves between two rings of pads faced with white metal, the pads being free to rock in the housings. These housings have conical seating surfaces machined at an angle of 45 degrees, so that it is a very simple matter to mount the whole assembly in a cast-iron housing of simple design. In Table 1 are given the principal dimensions for thrust collars of the type shown in the illustration for shafts from 1 to 3½ inches in diameter.

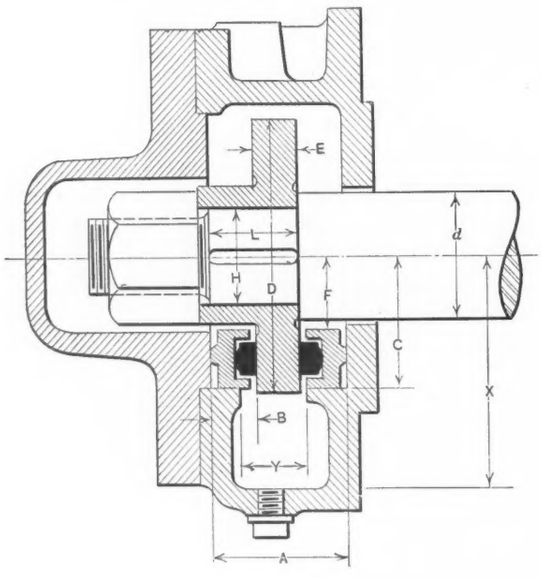
Thrust Washer for Vertical Shaft

The providing of suitable supporting bearings for a vertical shaft is a problem frequently met with, in which the pad system can be applied with excellent results. The illustration at the head of Table 3 shows a standard design provided with an oil-retaining case. The principal dimensions covering a range of shaft diameters from ¾ inch to 3 inches are given in this table.

End Thrust Bearings of Pad Construction

Centrifugal pumps, fans, worm-gears, etc., often require thrust bearings at the extreme end of the shaft. A suitable design for such service, provided with an oil-tight case, is shown in the illustration at the head of Table 2, which gives the important dimensions for shafts up to 6 inches in diameter. This type, however, is well suited to shafts up to 11 inches in diameter. When the shaft diameter does not exceed 3 inches, the standard thrust washer shown at the head of Table 1 can also be used in this type of bearing, the arrangement being as shown in Fig. 2.

TABLE 2. DIMENSIONS FOR END THRUST BEARINGS

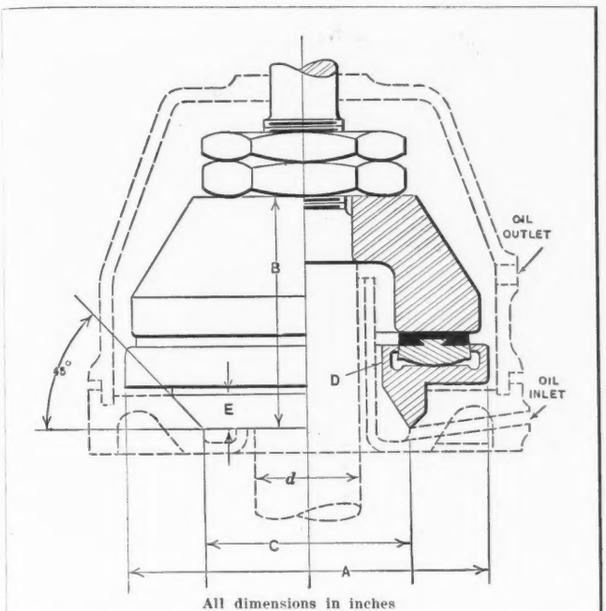


All dimensions in inches

d	A	B	C	D	E	F	H	L	X	Y	Max. Speed, R.P.M.	Max. Load, Pounds
1	1 7/16	17/32	1 11/32	2 1/2	3/8	5/8	3/4	1 1/16	2 1/2	11/16	3000	300
1 1/4	1 5/8	19/32	1 19/32	3	7/16	3/4	7/8	1 3/16	2 3/4	13/16	2500	500
1 1/2	1 15/16	23/32	1 7/8	3 1/2	1/2	7/8	1 1/16	1 3/8	3	29/32	2250	700
1 3/4	2 1/4	27/32	2 5/32	4	9/16	31/32	1 3/16	1 1/2	3 1/2	1 1/8	2000	900
2	2 5/8	15/16	2 31/32	5	3/4	1 1/4	1 5/8	1 7/8	4	1 5/16	1800	1400
2 1/2	3 1/8	1 1/8	3 3/16	6	7/8	1 1/2	2	2 1/8	4 1/2	1 1/2	1600	2000
3	3 5/8	1 5/16	3 11/16	7	1	1 3/4	2 3/8	2 1/2	5 1/4	1 5/8	1450	2800
3 1/2	4 1/8	1 1/2	4 1/4	8	1 1/8	2	2 3/4	2 7/8	6	1 13/16	1300	3600
4	5	1 13/16	5 1/4	10	1 3/8	2 17/32	3 1/2	3 1/2	7 1/2	2 1/8	1150	5600
5	5 3/4	2	6 5/16	12	1 3/4	3 1/8	4 1/2	4	9	2 5/8	1000	8000
6	6 1/2	2 1/4	7 3/8	14	2	3 5/8	5 1/4	4 1/2	10 3/8	3	850	11.000

Machinery

TABLE 3. DIMENSIONS FOR VERTICAL THRUST WASHERS



All dimensions in inches

Diam. of Shaft d	Size of Bearing D	A	B	C	E	Load in Pounds
3/4	1 1/4	2 7/8	2 1/16	1 3/4	5/16	750
1	1 1/2	3 3/8	2 7/16	2	7/16	1250
1 1/4	1 3/4	4	2 13/16	2 7/16	7/16	1850
1 1/2	2	4 1/2	3 3/16	2 3/4	1/2	2100
1 3/4	2 1/4	5 1/8	3 9/16	3 1/8	9/16	2700
2	2 1/2	5 3/4	3 15/16	3 1/2	5/8	3500
2 1/2	3	6 7/8	4 9/16	4 3/16	3/4	5400
2 3/4	3 1/2	8	5 3/16	4 7/8	7/8	6100
3	4	9	5 9/16	5 1/2	1	8450

Machinery

COST SYSTEM FOR THE JOBBING SHOP

A simple cost system for the jobbing shop, such as suggested in an editorial in February MACHINERY, page 432, is used by the American Tool & Mfg. Co., Urbana, Ohio. In this system three records are used: The labor ticket, as shown in Fig. 1; a material requisition, as illustrated in Fig. 2; and a loose-leaf book which is kept in the office and contains the complete records for each job.

As will be seen, the labor ticket contains the employe's name, his clock number, and the date on which the card is made out. Each man fills in a labor ticket every day and turns it over to the superintendent at night. On this ticket the workman fills in the number of the job on which he has been working, which corresponds to the number given to this job in the loose-leaf book mentioned. A space is also left for filling in the name of the company or person for whom the work is done, but when the job number is given, this information is not generally required and is frequently left out. The time when the man started and stopped each job is entered, and the total time recorded in the last column. The ticket is signed by the foreman after it has been completely filled out, and turned in to the superintendent in order to complete the office records.

The material requisition is made out by the foreman, and then given to the stock clerk, who puts all the material for the order together and notes the weights on the requisition. The material requisition specifies both castings and bar stock. If patterns have been made specially for the job, the cost of the patterns is also recorded.

From these two records the information kept in the loose-leaf book in the office is filled in. In this book are entered the order number, the total time worked on the job by each man, and his rate of wages. All material used on the job is also entered, together with its cost. In this way, a complete record of the cost of the completed job is always on hand, and comparatively little bookkeeping or accounting is required. A similar simple system for keeping costs in a jobbing shop would doubtless prove of value to many that are engaged in this field.

LABOR TICKET. AMERICAN TOOL & MFG. CO.

Employe's Name James Brown No. 6 Date 2/11/24

This Ticket MUST be Properly Filled in and Returned to Supt. Each Night.

Job No.	For Whom	Started	Stopped	Total Time
5304		6 30	10 30	4
5340		10 30	11 30	1
5340		12 30	5 30	5

John Smith Foreman.

Fig. 1. Labor Ticket for Jobbing Shop Cost System

American Tool & Mfg. Co.
URBANA, OHIO

Material Requisition

Date 2/11/24 To Apply on Shop Order No. 5304

Pattern No. 3-LLD- $12.00
3-LLP- $6.00

Amt.	MATERIAL	Total Wt.
	Castings	
1	3-LLD	130 lbs
1	3-LLP	60 lbs

John Smith Foreman

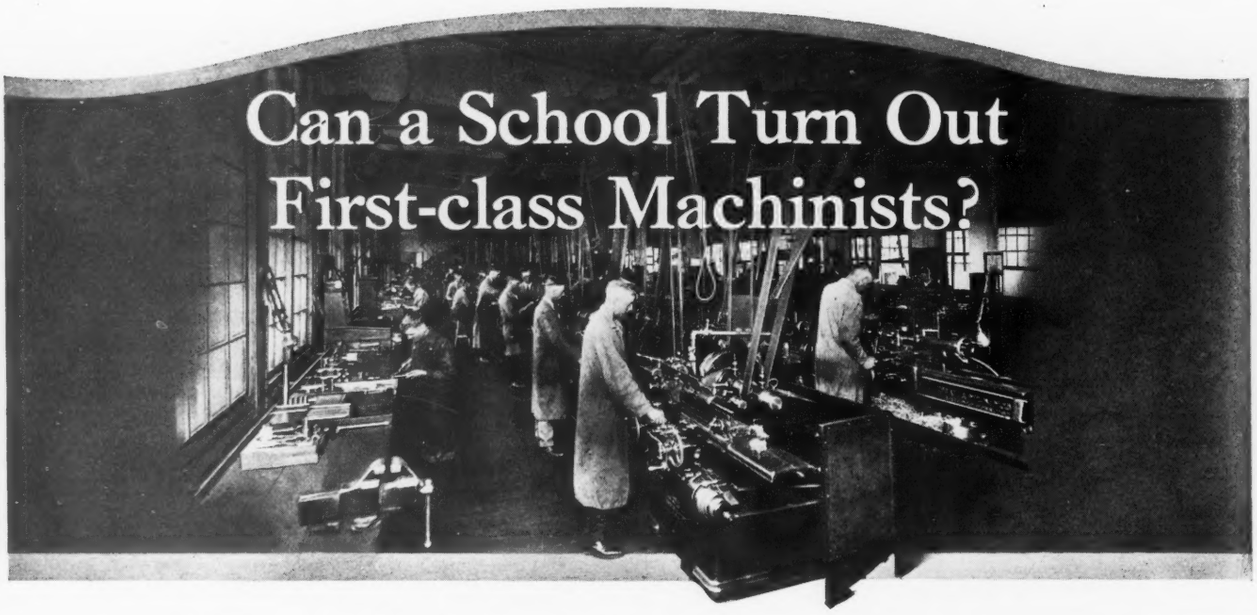
Fig. 2. Material Requisition used in Jobbing Shop

* * *

IS THERE NEED FOR STANDARDIZATION?

A contemporary journal calls attention to the fact that one prominent make of six-cylinder passenger car uses 27 sizes of nuts, 98 sizes and types of machine screws, 57 sizes of wood screws, 7 sizes of carriage bolts, 16 sizes of cotter-pins, 5 sizes of Whitney keys, 12 sizes of lock-washers, and 19 sizes of rivets. This is in the automobile field where standardization has been carried forward to a greater extent than in practically any other machine-building industry. If anybody ever talks about standardization being carried to an extreme, just show him this list and ask him whether he does not think that we could afford to pay even a little more attention to standardization work than we have in the past, without seriously handicapping progress and preventing the development of individual designs in industry.

Can a School Turn Out First-class Machinists?



Methods Followed in a Trade School Machine Shop that is Run on a Commercial Basis

By CHARLES O. HERB

As you pass up the steps to the main entrance of the Worcester Boys Trade School, Worcester, Mass., your eyes are attracted by a bronze tablet on each side. That on the right-hand side is in commemoration of the late Milton Prince Higgins, machinist, manufacturer, and educator of Worcester, who was virtually the founder of the school. The opposite tablet is inscribed with Mr. Higgins' philosophy of learning a trade: "To make a good living; to have a happy family; to make preparation for hard times; to wear overalls in the shop with the same dignity as good clothes are worn on Sunday; to be confident you are laying a sure foundation for any future success; to feel that you are master of your work and that you share the creative spirit. This is the wholesome philosophy of learning a trade." This homely creed, thus conspicuously displayed, should serve as a constant inspiration to every student.

Ten trades are taught at this school—mechanical drafting, machine shop practice, patternmaking, cabinet making, carpentry, electrical work, printing, automobile mechanics, painting, and wood finishing. To obtain a diploma, the student must complete 4000 hours of acceptable shop work, and must spend about the same number of hours in academic and correlated subjects selected to give the necessary theory of the trade he is learning.

Each school year consists of forty-two weeks divided into three terms. The student spends one week in the shop and the alternate week in the classroom. When in the shop, he attends from 8 o'clock in the morning until 5 in the afternoon every day except Saturdays, while the hours for classroom work are from 9 to 4 daily except Saturdays. A summer session of six weeks is held to provide an opportunity for the student to make up lost time for unsatisfactory work, and he may attend Saturday mornings for the same purpose. The day school is open to boys from 14 to 25 years of age.

Students residing outside the limits of Worcester but within the state of Massachusetts may attend the school upon the payment of a nominal charge, which is generally defrayed by the authorities of the town in which the student

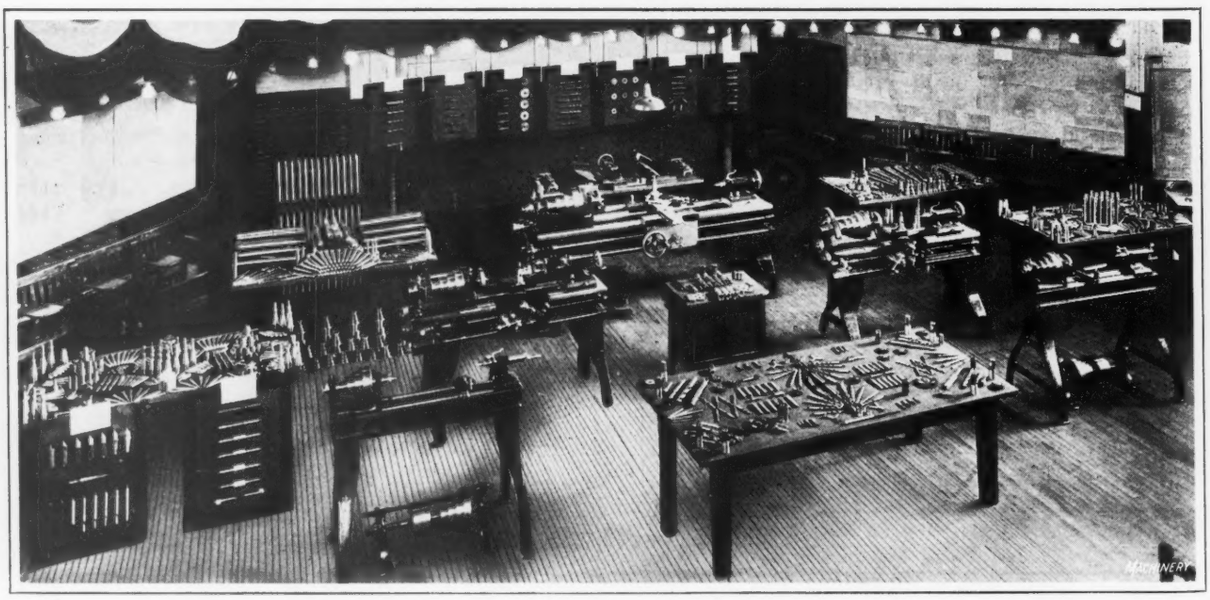


Fig. 1. Exhibition of Work made by the Machine Shop Students to fill Orders from Machine Builders or for Use in the Shop

lives. An evening session, held on four nights a week, is open to all men who desire further instruction along the line of their daily work. Then too, there are some rehabilitation students. There are many points of interest in this school, but it will be necessary to confine the present article chiefly to the methods followed in developing first-class machinists and toolmakers.

Running the Machine Shop on a Commercial Basis

In this school the attempt is made to run the machine shop on a commercial basis, and the attempt is successful. It is not primarily the intention to make the work produced cover the expense of maintaining the department, but rather to have every piece of work turned out put to a useful purpose. In this way the boys have a feeling of responsibility that is not engendered in the ordinary trade school, and there is an incentive for them to do their best. Besides, a real shop atmosphere is produced, because practically all work is put through in quantities. Even the first piece of work of a new boy is finished by more advanced students, on all dimensions are plus or minus 0.003 inch. The slot is made with a two-edge cotter mill, running at a speed of about 800 revolutions per minute. The tap used for producing the threaded hole in this part is also made by the boys.

The example shown at *D* is turned out at the rate of 3000 per year. The boys are taught to center this part by the use of a bent leg divider, prick-punch, and hammer. The care with which they learn to do this will be apparent from the fact that the part is turned from 2 7/16-inch stock which provides a leeway of only 1/16 inch on the diameter. Heavy turning cuts are taken on this piece, and in order to insure that the ends will be square with the center holes and the cylindrical surfaces, the ends are left rough until the part has been finish-turned and necked, after which facing cuts are taken.

Is There Enough Work to Keep the Shop Busy?

A large variety of parts made by the boys mainly for outside concerns is illustrated in Fig. 1. This illustration also

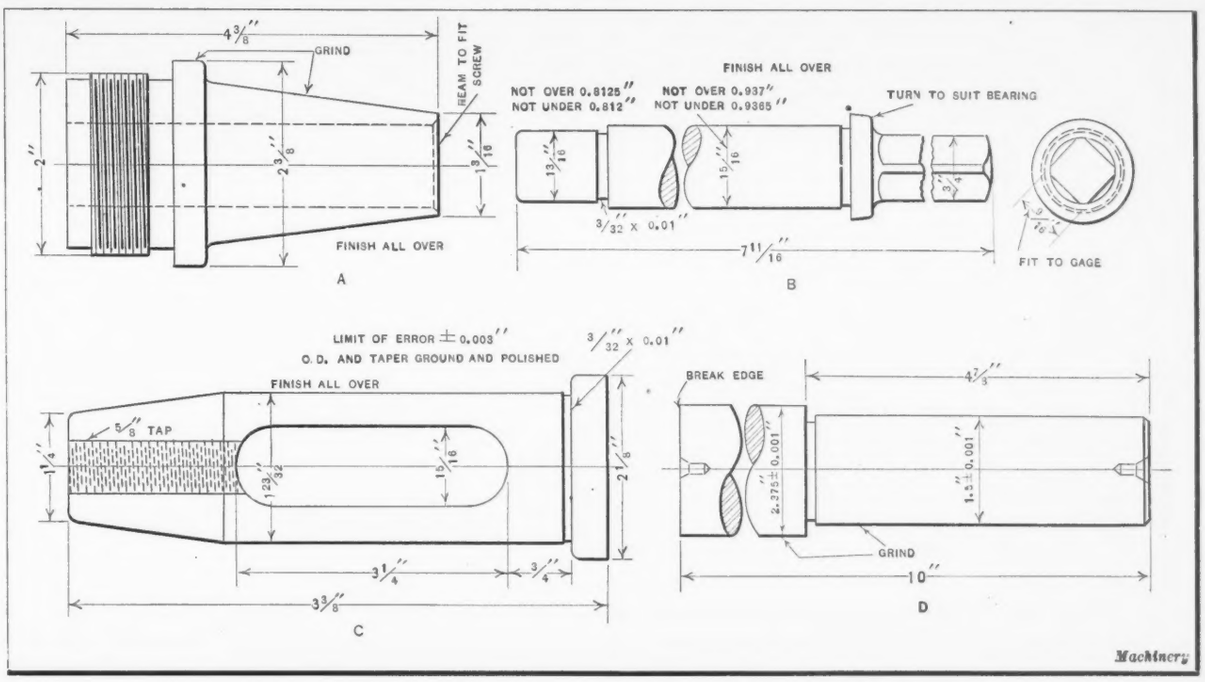


Fig. 2. Examples of Machine Tool Parts turned out in Large Quantities by the Students

either for an order that the shop is filling for some manufacturing concern or for use in the school itself.

The question will immediately be raised as to what sort of work these students can supply for a manufacturing concern. Most orders are obtained from machine tool builders for parts that must be accurately produced. Typical examples of the class of work handled are shown in Fig. 2. Part *A* is a bearing for an adjusting screw supplied on the ram of a well-known shaper, while part *B* is the adjusting screw which mates with this bearing. Each of these parts has been turned out by the school at the rate of 150 a month for a period of three years.

In order that the student may learn his trade thoroughly, he is taught both old and modern methods of machining parts. For instance, the thread of part *A* is cut with a single-point tool; when finished, it must fit a Pratt & Whitney thread gage, but it is also measured by the three-wire system. This job is performed entirely on an engine lathe except for boring and reaming the hole, which is done on a turret lathe. The square end of the ram adjusting screw is straddle-milled, twelve pieces at a time, a special fixture being employed for this operation.

At *C* in Fig. 2 is shown a lathe toolpost, fifty of which have been produced per month for over two years. This part is made from 0.45 per cent carbon steel, and the limits shows a number of lathes built for the school itself. In building these machines, the school obtained drawings of lathes formerly built by a well-known manufacturer, from which new drawings and patterns were made. As the lathes are of up-to-date design, except that there is no quick-change gear-box, they are suitable for instruction purposes and gave excellent practice for the boys in building them. Twenty-five lathes of 14-inch swing were built for the school; this obviously considerably reduced the cost of equipment.

Some complete units and machines have also been made for outside concerns. The good reputation that the products of the school have cannot be better emphasized than by mentioning that when the writer was visiting the school, an order was received for twelve saw sharpening machines, in which it was stated that all twelve machines should be put through at one time instead of first building one for approval. Among the parts made in large quantities for concerns is included the small cone pulley shown near the left-hand side of Fig. 1. More orders of this type are available than can be filled.

The Shop Work Courses

One of Mr. Higgins' theories in regard to trade schools was that the school should be a shop with a school attach-

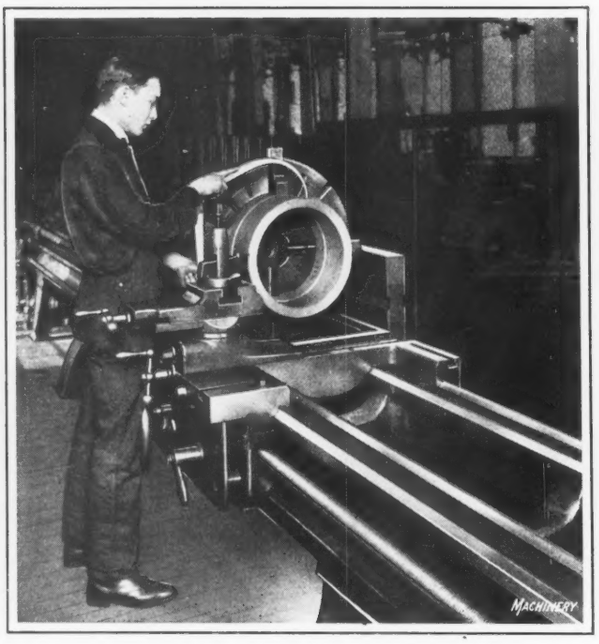


Fig. 3. Interesting Example of Finish Boring and Turning

ment rather than a school with a shop attachment as is so frequently the case when trade schools are run by an educator rather than by a principal who has done practical work. It will be realized from the foregoing description that this school is primarily a shop, and there is plenty of real shop atmosphere, as will be apparent from the heading illustration. Mr. Higgins also decried the fact that in many trade schools much good material is used by the boys for mere exercises in which they simply make things to resemble useful products, which are later thrown away. It was his belief that things could be made entirely for sale on the open market or for replacing and enlarging the equipment of the school, and this belief has now been proved to be a practical one. Of the parts made for outside companies, the lost and spoiled work is probably not more than 5 per cent.

New boys coming into the machine shop spend their first week in getting acquainted and learning the names of the machines. Then at the beginning of the second week they are put on lathe work. There are no preliminary filing or chipping exercises such as are so common in trade schools, as they are believed to be so tedious and uninteresting to new boys as to discourage them. During the first year the boy spends practically all his time at the lathe. He starts with rough-turning operations and ends with taper-turning and thread-cutting. In the second year more instruction is given on the lathe and also on the turret lathe and milling machine.

At the beginning of the third year the student is taught to cut spur, spiral, and worm gears, and is then given grinding, planing and tool-room work, while his fourth year consists of instruction in milling, toolmaking, lapping, etc. In toolmaking he is taught how to make reamers, milling cutters, taps, etc., and drill jigs for use in production work. At some time during the course, the boy serves time in the tool-crib in order to become familar with the methods of storing and checking out tools. While in the crib his leisure time is occupied in sharpening tools. The shop equipment includes forty-five lathes, six milling machines, twelve shapers, six planers, two boring mills, four upright drilling machines, a gear-hobber, an automatic bevel gear cutter, grinding machines, four power hacksaws, and a well furnished heat-treating department.

Particular stress is laid on training the boy to be resourceful, and for this reason primitive methods are often used, so that when the boy is earning his livelihood at the trade he will not be at a loss in case an operation is to be performed for which he has no up-to-date tools. For instance, when the writer was at the school the cylinder casting of a steam engine was set up on a boring mill, and had just been bored to 15.147 and 9.193 inches, respectively. There had been no suitable boring head on hand for this job, and so the larger hole had been bored by mounting the cutters on an old faceplate slotted to receive them. For the smaller bore, the tools were held on an old gear similarly slotted. The method was crude, but the bores were accurate and smooth. When work is not satisfactory, the boy is allowed a number of hours less than he would ordinarily get for the job, and he has to make up all such work by staying over-time before he can receive a diploma.

Shop Instructions and Academic Work

During the week that the boys are in the school they go in groups each day for an hour of "shop instruction," at which time the supervisor of the shop explains to them methods and theories related to the machinist trade. In this class, for instance, are taught the mathematics of the trade, such as how to figure change-gears and how to determine the amount that a lathe tailstock should be set over for turning tapers; the application and method of reading micrometers and verniers; methods of holding work on different machines; how to choose tools for different operations to obtain the greatest economy; application of formulas, especially those relating to gears; and different types of lathe chucks and other equipment.

The academic training of the student is just as thorough as the shop work, the aim being not merely to make the graduate machinist a first-class mechanic, but also to give him a well rounded general education that will qualify him to hold a responsible position in the industrial world and a respected place in the community. In the academic week the subjects taught include arithmetic, mechanical drawing, geometry, algebra, trigonometry, history, English, civics, science, and cost accounting. The student also spends two hours a week in the gymnasium and one hour in a general assembly, at which time either a well-known business or professional man or someone in political life addresses the boys, or an educational moving picture is shown, followed by a comedy reel.

It is, of course, important that the machine shop student know how to make and read mechanical drawings, so he

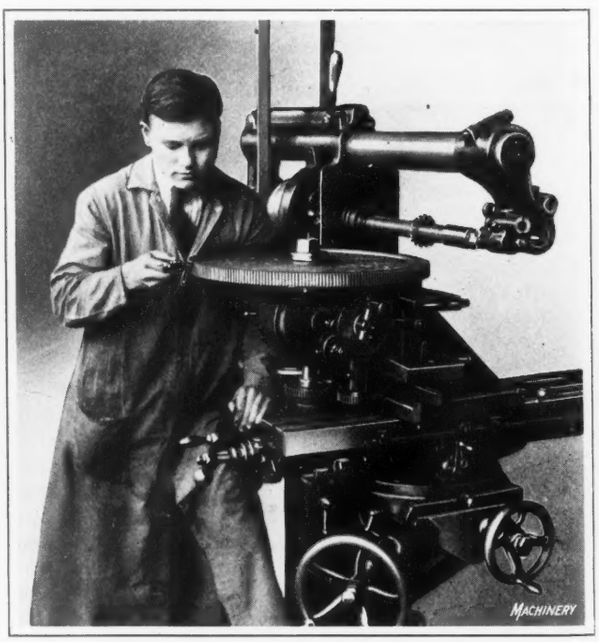


Fig. 4. Unusual Set-up employed on a Milling Machine for cutting the Teeth of a Spur Gear

spends one entire term of his shop work in the drawing-room during the four-year course, and five hours a week is devoted to drawing during the entire course. He is taught how to make free-hand sketches and work from them, first making sketches from models and large drawings having one view missing, and then from actual parts in the shop. Most of the machine shop students take kindly to drawing because they soon learn its value in the trade. None of the drawings are inked in, in the academic classes. In cost accounting, no attempt is made to produce finished accountants, but the principles are taught so that should a boy at some time start a business of his own, he will not simply count material and labor in his costs, as is often the case, but will also include overhead.

What Sort of Machinists does the School Turn Out?

It would be ridiculous to suppose that any school could turn out machinists as capable as men who have served their time and worked years in the shop, but with a little outside experience, the boys trained in this school should soon forge ahead. As a matter of fact, immediately upon graduation all boys can obtain employment at good wages in Worcester because of the confidence that manufacturers in the vicinity have in the school. Almost without exception the boys succeed, and this statement has been substantiated in a number of shops where graduates are employed. A record is kept of each graduate which shows the place where he is employed and the position he holds.

It must not be inferred that every boy who enters the machine shop can be developed into a machinist or that all students go through the entire four years of the course. If a boy has no mechanical tendencies, this becomes evident early and he is persuaded to take other work. About 40 per cent of the boys who become regular students in the shop go through the course to the end and graduate. There are about 180 day students in the machine shop at present and 85 night students. The courses in mechanical drafting and patternmaking will be described in a later article.

* * *

THE SCIENCE OF CUTTING METAL

By JOHN AIREY, King-Seeley Corporation, Ann Arbor, Mich.

This article is a plea for a change in point of view on the subject of metal-cutting investigations. Those familiar with research in various fields cannot fail to observe that, in the subject of metal cutting, an attitude of "boring from above" exists, as opposed to the establishment of fundamentals and building up therefrom, as found in other fields.

Frederick W. Taylor founded this subject, and his contribution is classical. Only those well versed in the subject appreciate the magnitude, and above all, the pioneer nature of the work he accomplished. However, his work has been misinterpreted and too slavishly followed—in thought more than in action. The time is ripe for looking upon the subject from a new point of view. The thought intended is best approached by hyperbole—Taylor discovered the existence of a vast unsuspected continent. He noted various mountains, rivers, and valleys, but had no time to take latitudes or longitudes. Subsequent investigators have made hurried excursions into this continent and have done exactly the same thing. The value of all this work is seriously impaired, because the location of everything is unknown. A systematic, elementary work should be done first to provide a framework into which all later observations can be fitted and coordinated, so as to form a coherent whole.

To come back to the subject—investigators have worked from the surface downward, rather than from the bottom upward. Taylor gave us the expression "The Art of Cutting Metal." Because of tradition, the term *art* has not been superseded by *science*. This fact is probably partly responsible for the viewpoint that has handicapped investigations.

The subject has one fundamental plane of cleavage into the two divisions outlined in the following. The connection between the two is comparatively slight and could, for the immediate future, be ignored.

1. A study of the forces in cutting metal with tools of known geometrical shape, which are infinitely sharp or of a scientifically known degree of bluntness.

It appears axiomatic that all forces involved would be exactly the same if two tools were used of the same geometrical definition, irrespective of the quality of the tool steel. Whatever steps are necessary to keep constant the geometrical definition, must be taken.

2. A study of the permanence of a given geometrical form of tool for various kinds of steel, different conditions of hardening, and kinds of usage.

Research on this subject, truly building up from the bottom, will require several years before fruits are obtained of commercial value. In the meantime, commercial interest will require information on specific types of action and will necessarily proceed by the method of "boring from above." The better plan, in the writer's opinion, appears to be for the American Society of Mechanical Engineers to restrict its activity to the fundamental work. The surface work could well be left decentralized. Coordination of this class of work is of doubtful value in the absence of the underlying structure.

Investigation should first be restricted to the most elementary phenomenon, namely, rectilineal cutting. The goal of this is to express the energy required to remove a unit volume of chips as a rational function of the physical properties of the material, of the tool shape, and of the cut configuration. When this big fundamental problem is solved, an analytical tool of the first magnitude will be available, and this will be applicable to all types of action as a starting point.

The solution of the problem mentioned in the last paragraph will involve the establishment of a *mechanism of failure* of material under compound stress. (The expression *mechanism of failure* is used to denote a theory covering the action when a metal fails, whether by tension, compression, or shear. We know that all three methods of failure are closely inter-related, but as yet a fundamental theory giving a basic criterion of rupture has not been recorded.) This, in itself, is a problem of a very high order, entirely apart from its application to the cutting of metal, and incidentally, could be made to form good grounds for the support of the American Society of Civil Engineers, as they are also vitally interested in this problem.

To lay out a comprehensive program in the science of cutting metal, beyond two or three basic topics, is groping in the dark. The solution, or partial solution, of these basic topics would shed such an illumination on other matters as to cause a different interpretation of results and consequent change in cast of program. The biggest difficulty is in the first step, and the very best analytical and experimental talent will be needed in the successful taking of it. If our two leading national engineering societies would join forces to further the establishment of a *mechanism of failure* of metal under compound stress, then the real foundation stone would be laid in the science of cutting metal.

* * *

Are you of the sort that resents any suggestion that you could make an improvement in your work? Do you take offense at once if a criticism is made? Do you make remarks of this order: "So and so cannot teach me anything. My work is just as good as his, and I do not know why I should be pulled to pieces if I am just as good." But are you "just as good," and is that as far as your aim goes? Is it too much trouble to study to be better than the other fellow, and is that why you resent anything which would make you work harder? Your attitude should be one of constant alertness to find out in what the other fellow excels. You should be glad to know how you could increase your knowledge or your speed for turning out good work. —*The Highway Builder*



Design of Inclinable Power Presses



Calculations for Designing the Gearing, Driving Shaft, Back-shaft Bearing, Flywheel and Pulleys

By P. A. FRIEDELL

WHEN an inclinable press is to be used for any operations except very shallow drawing and forming, it should be provided with reduction gearing. Gearing is not required if the stroke is short, unless it is desired to feed the press by hand while running continuously, or for some similar reason. The most satisfactory speed for drawing and heavy blanking and piercing operations may be determined by the formula,

$$N = \frac{96}{t}$$

in which

t = throw of crankshaft; and

N = number of revolutions of crankshaft per minute.

Then, assuming t to be 1 inch,

$$N = \frac{96}{1} = 96$$

For blanking and piercing the lighter gages of metal, say No. 16 U. S. standard or lighter, the speed may be

$$N = \frac{125}{t} = \frac{125}{1} = 125$$

For purposes of calculation, it will be assumed that a press is to be equipped with a crankshaft having a 4-inch stroke, and is to be used for drawing, blanking, and other operations. Then,

$$N = \frac{96}{2} = 48$$

Lineshafting is usually run at a speed of about 200 revolutions per minute, and therefore that value will be used in the following calculations. Advantage may be gained in having the driving and driven pulleys the same diameter where permissible, as a 180-degree angle of belt contact is thereby obtained on both pulleys, reducing slippage to a minimum.

Calculations for the Gear and Pinion

If J represents the speed of the driving shaft, in revolutions per minute, and R, the ratio of the gearing, $R = \frac{J}{N}$. Assuming that J and N equal 200 and 48 revolutions per minute, respectively, $R = \frac{200}{48} = 4.17$ to 1. If it is assumed that a center distance C of approximately 22 inches is satisfactory, the trial diameter of the pinion and gear and other dimensions may be determined. In the formulas to be employed, the following nomenclature is used:

D = pitch diameter of pinion;

T = pitch diameter of gear;

d = twisting moment on crankshaft (assumed as 100,000 inch-pounds);

V = velocity at pitch line of gear, in feet per minute;

P_1 = circular pitch of gear and pinion;

P = diametral pitch of gear and pinion;

A = width of face;

L = tooth pressure at pitch line of gear and pinion;

H = maximum horsepower consumed by press;

a = a constant which represents the relative width of face compared to the velocity;

Y = tooth outline factor used in Lewis formula for the strength of gear teeth = about 0.360 for 63 teeth of 14½-degree involute form; (See MACHINERY'S HANDBOOK, page 595.)

W = maximum safe tangential load at pitch diameter;

S = safe stress for material at given velocity. (See MACHINERY'S HANDBOOK, page 596.)

Then,

$$d \text{ (trial diameter)} = \frac{2C}{R+1} = \frac{2 \times 22}{4.17+1} = 8.51 \text{ or } 8\tfrac{1}{2} \text{ inches}$$

$$D \text{ (trial diameter)} = 8.51 \times 4.17 = 35.48 \text{ or } 35.5 \text{ inches}$$

$$V \text{ (trial velocity)} = 0.262DN = 0.262 \times 35.5 \times 48 = 446 \text{ feet per minute}$$

$$H = \frac{0.5236TN}{33{,}000} = \frac{0.5236 \times 100{,}000 \times 48}{33{,}000} = 76.16$$

$$L = \frac{2T}{D} = \frac{2 \times 100{,}000}{35.5} = 5630 \text{ pounds}$$

$$a = \frac{0.15\sqrt{V}+9}{3.1416} = \frac{0.15\sqrt{446}+9}{3.1416} = 3.873$$

Assuming that the gear is to be made of cast iron and the pinion of machine steel,

$$P_1 \text{ (pinion, approximate)} = \sqrt{\frac{6.9TN}{SVa}} = \sqrt{\frac{6.9 \times 100{,}000 \times 48}{11{,}400 \times 446 \times 3.873}} = 1.297 \text{ inches}$$

$$P_1 \text{ (gear, approximate)} = \sqrt{\frac{4.5TN}{SVa}} = \sqrt{\frac{4.5 \times 100{,}000 \times 48}{4550 \times 446 \times 3.873}} = 1.657 \text{ inches}$$

As the gear is the weaker member, the next higher corresponding standard diametral pitch to 1.657 inches will be adopted for the pinion and gear. This is 1¾ diametral pitch or 1.795 inches circular pitch. Assuming 15 teeth for the pinion, the gear will have $15 \times 4.17 = 62.55$, say 63 teeth. Now, $A = P_1a = 1.795 \times 3.873 = 6.95$, say 7 inches.

Using the Lewis formula (page 595 of MACHINERY'S HANDBOOK) for calculating the safe tooth load,

$$W = \frac{SAY}{P} = \frac{4550 \times 7 \times 0.360}{1.75} = 6552 \text{ pounds}$$

Had the next lower value been taken for the diametral pitch, the safe load would have been too low, as

$$A = 1.5708 \times 3.873 = 6 \text{ inches}$$

$$W = \frac{4550 \times 6 \times 0.360}{2} = 4914 \text{ pounds}$$

The actual center distance with a 63-tooth gear and a 15-tooth pinion of 1¾ diametral pitch is:

$$C = \frac{15 + 63}{2 \times 1.75} = 22.286 \text{ inches}$$

Also

$$d = \frac{15}{1.75} = 8.570 \text{ inches}$$

$$D = \frac{63}{1.75} = 36 \text{ inches}$$

Determining the Driving Shaft Diameter

The driving shaft is subjected to both torsional and bending stresses and should be designed to take care of both. The twisting moment on the driving shaft is:

$$T_1 = \frac{Ld}{2} = \frac{5630 \times 8.570}{2} = 24{,}120 \text{ inch-pounds}$$

The bending moment M may be calculated as a cantilever beam with the load L distributed evenly over a length A (see illustration) thus,

$$M = \frac{5630 \times 7}{2} = 19{,}700 \text{ inch-pounds}$$

The combined moment equals

$$T_2 = \sqrt{T_1^2 + M^2} = \sqrt{24{,}120^2 + 19{,}700^2} = 31{,}140 \text{ inch-pounds}$$

Then, if E = diameter of driving shaft, and T_2 = combined bending and twisting moment,

$$E = 0.102 \sqrt[3]{T_2} = 0.102 \sqrt[3]{31{,}140} = 3.21, \text{ say } 3\tfrac{1}{4} \text{ inches}$$

Designing the Back-shaft Bearings

The back-shaft bearings for an inclinable press may be constructed as a unit, to be bolted to the rear of the housings, as shown in the illustration. The length of the back-shaft bearings should each be not less than $2E$, preferably from $2.5E$ to $3E$ where the pinion and flywheel are overhung. Then

$$2E = 2 \times 3.25 = 6.5 \text{ inches}$$

The minimum length F of the bearings may be calculated by the formula,

$$F = \frac{W}{55E}\sqrt{\frac{400 + V}{800}}$$

in which

W = weight of flywheel, pulleys, and other parts at flywheel end of shaft, or tooth pressure on the pinion divided by 4; and

V = peripheral velocity of the driving shaft, in feet per minute. The speed of the driving shaft = $4.17N$ = $4.17 \times 48 = 200$ revolutions per minute.

Assuming a weight of 1000 pounds for the flywheel end and substituting this value for W in the formula,

$$F = \frac{1000}{55 \times 3.25}\sqrt{\frac{400 + (0.262 \times 3.25 \times 200)}{800}} = 4.72 \text{ inches}$$

Next, substituting for W the tooth pressure on the pinion divided by 4,

$$F = \frac{5630}{4 \times 55 \times 3.25}\sqrt{\frac{400 + (0.262 \times 3.25 \times 200)}{800}}$$

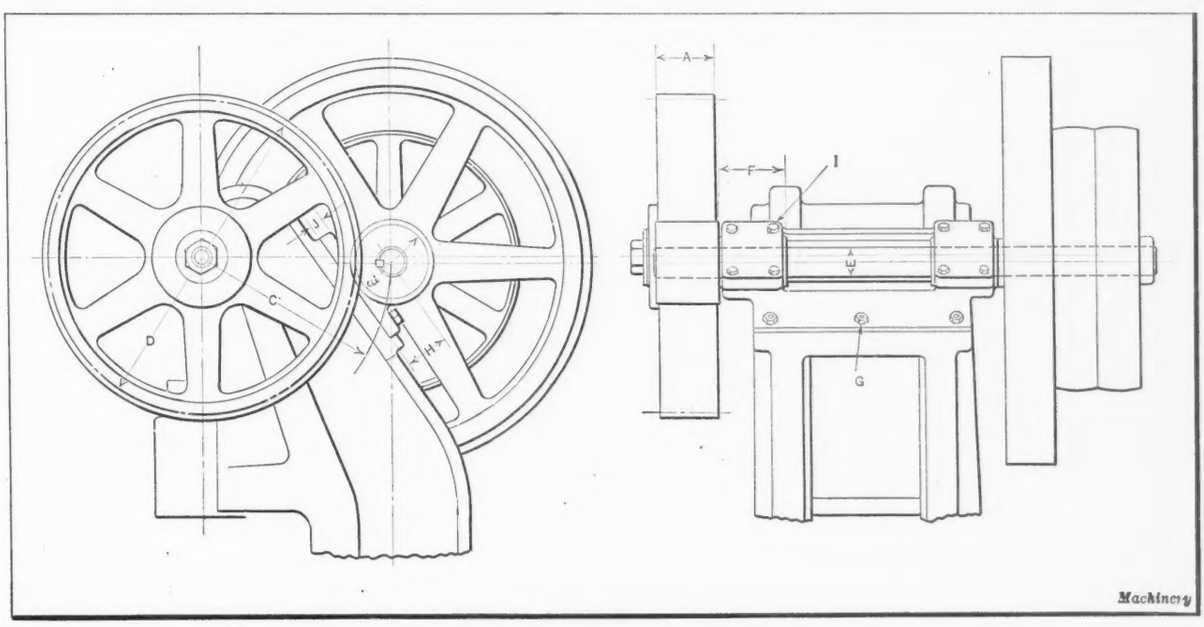
$= 6.648$, say 6¾ inches

The latter or a greater length should be used. This formula gives very satisfactory results with babbitted bearings, properly scraped in.

Height H, from the base of the bracket to the center of the shaft equals $1.5E = 1.5 \times 3.25 = 4.87$, say 5 inches. Thickness J of the bracket pad may be made equal to $0.2E + 0.25 = 0.2 \times 3.25 + 0.25 = 0.9$, say 1 inch. The diameter of the cap studs $G = 0.15E + 0.25 = 0.15 \times 3.25 + 0.25 = 0.737$ or ¾ inch. The diameter of pad studs $I = G + 0.125 = 0.750 + 0.125 = 0.875$ inch.

Calculating Weight of Flywheel Rim for a Geared Press

For a geared press, the flywheel should be calculated so as to provide sufficient energy to cover the maximum capacity of the press, which in the present case is 50 tons. The maximum capacity with a crankshaft having a 4-inch stroke can only by utilized through a distance X of 0.3 inch as shown by calculations on page 284 of December, 1922, MACHINERY. Therefore, at 50 tons the capacity would be $0.3 \times 50 = 15$ inch-tons, or 30,000 inch-pounds. At the center of the stroke the capacity would be 25 tons $\times$ 2 inches = 100,000 inch-pounds or 8333 foot-pounds.



Arrangement of the Driving Unit on a Geared Inclinable Power Press

Assuming a flywheel 45 inches in mean diameter, the velocity = 0.262 × 45 × 200 = 2358 feet per minute = 39.3 feet per second. The horsepower required at the maximum capacity = $\frac{8333 \times 48}{33{,}000}$ = 12.12, provided the press is to be operated at maximum capacity continuously. This speed is seldom attained, except with an automatic feed. The 8333 foot-pounds of energy is consumed by the press in $\frac{60}{N} \times \frac{1}{\text{stroke}} = \frac{60}{48} \times \frac{1}{4}$ = 0.3125 second.

The power transmitted by the belt during this period = 12.12 × 550 × 0.3125 = 2083 foot-pounds. Then the actual energy required from the flywheel = 8333 — 2083 = 6250 foot-pounds. Now, the required weight of the flywheel rim may be calculated by means of the following formula which is given in MACHINERY'S HANDBOOK, page 288:

$$W = \frac{E_1 \times 64.32}{v_1^2 - v_2^2}$$

in which

W = weight of flywheel rim, in pounds;
E_1 = energy, in foot-pounds, that a flywheel will give out while the speed is reduced from v_1 to v_2;
v_1 = velocity at mean radius of flywheel rim before any energy has been given out, in feet per second; and
v_2 = velocity of flywheel rim at end of period during which the energy has been given out, in feet per second.

Allowing a speed reduction of 20 per cent during the giving out of energy by the flywheel, the speed of the flywheel at the end of the period will be 0.80 × 39.3 = 31.44 feet per second. Then

$$W = \frac{6250 \times 64.32}{39.3^2 - 31.44^2} = 724 \text{ pounds}$$

It is necessary that the speed of the flywheel be increased from 31.44 to 39.3 feet per second in the remainder of the stroke after the work has been done. The time for this acceleration = 1.25 — 0.3125 = 0.9375 second.

The acceleration equals

$$a = \frac{39.3 - 31.44}{0.9375} = 8.38 \text{ feet per second, each second}$$

The force required is equal to

$$F = \frac{Wa}{32.16} = \frac{724 \times 8.38}{32.16} = 188 \text{ pounds}$$

The horsepower required to obtain this acceleration is equivalent to

$$\frac{60 v_1 F}{33{,}000} = \frac{60 \times 39.3 \times 188}{33{,}000} = 13.4$$

Considering friction, the power consumed by the brake, etc., about 15 horsepower should be allowed; of course, if it were not intended to run the press continuously at full capacity, less power would be required. The method of calculating the flywheel dimensions was presented in the article in July, 1923, MACHINERY, page 876.

Tight and Loose Pulleys

Both tight and loose pulleys should be provided on all geared power presses when belt-driven. If the flywheel is not too large, it may be utilized as the tight pulley. The loose pulley should be a little smaller in diameter than the tight pulley, say ⅛ inch, which will result in a slight relaxation of the tension on the belt when running idle, and a decrease in the pressure on the bearing of the pulley. Assuming a diameter of 30 inches for the pulleys, the belt speed equals 0.262 × 30 × 200 = 1572 feet per minute. If a double belt is used on the press, the width may be determined by the formula

$$W = \frac{1925 \text{ H.P.}}{DN}$$

in which

W = width of belt in inches;
D = diameter of pulley in inches;
N = number of revolutions per minute of pulley;
H.P. = horsepower consumed in doing the work.

Substituting the values in this formula,

$$W = \frac{1925 \times 15}{30 \times 200} = 4.8, \text{ say 5 inches}$$

The pulleys should be from ¼ to ½ inch wider than the belt.

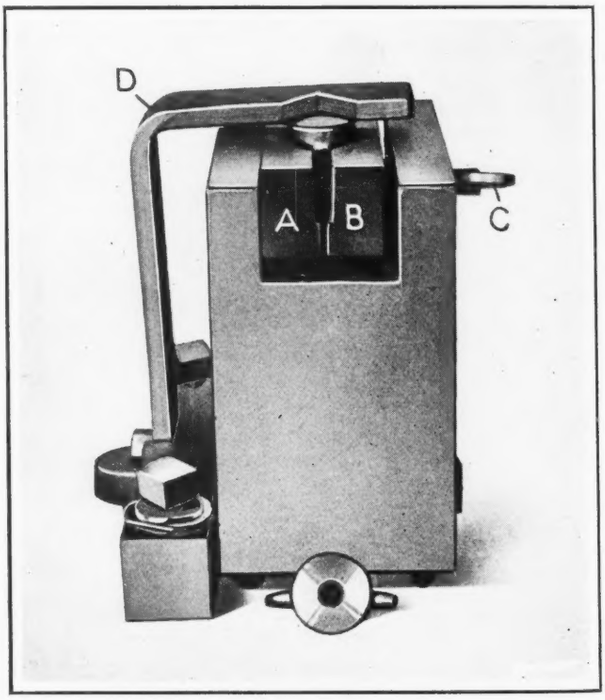
This is the conclusion of a series of five articles dealing with the design of inclinable power presses, which appeared in January, July and December, 1923, MACHINERY and February, 1924. These articles have presented formulas for calculating all the principal parts of this type of press, including the crankshaft, bearings, frame, flywheel, brake mechanism, inclining mechanism, gearing, shafts, and pulleys.

* * *

JIG FOR DRILLING AND TAPPING WING-NUTS

By ROBERT MAWSON

The accompanying illustration shows a jig used for drilling and tapping wing-nuts which are purchased in blank form, as is often done when the nuts are required for threaded bolts of different sizes. The wing portion of the nut is located by means of the stationary jaw A. The sliding jaw B is clamped against the opposite side of the wing portion of the nut by tightening the screw C. The locating strap D which is made with a V-shaped notch on the upper part is used to locate and also to assist in holding the work during the machining operation.



Drill Jig for Wing-nuts

* * *

The American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa., is undertaking work of ever-increasing importance in the engineering field. There were 532 new members elected in 1923. The membership at the close of the year was 3393, the net increase being 290.

Letters on Practical Subjects



PIERCING, COUNTERSINKING AND BLANKING DIE

The punch and die shown in the accompanying illustrations are used to produce the small plate *R*, Fig. 1. This plate is made of hard steel, 0.040 inch thick, and is pierced, countersunk, and blanked at a production rate of 3000 pieces per hour. The countersunk holes are required to be accurately positioned, and all the dimensions, some of which are shown in the illustration, have to be held within close limits. The die is of the pillar type and can be quickly set up on the press. The cast-iron die-shoe *A*, Figs. 1 and 2, has a slot milled in its upper surface into which the die-block *B* is fitted. The die-block is made from tool steel and contains four bushings, two for the piercing punches *C*, Fig. 2, and two for the countersinking punches *D*. It also contains a rectangular opening for the blanking punch *E*.

Stripper *F* is made of machine steel, and is held in place by four fillister-head screws and three dowels which extend through the die-block into the die-shoe. The strips *G* that guide the stock are ⅛ inch thick. The holes in the stripper plate are reamed so that they are a good fit for the small piercing punches, but the holes for the countersinking punches have a clearance of 1/64 inch. The rectangular opening is a close fit for the blanking punch. A stripper plate machined in this way serves to support the punch, and thus lessens the danger of the punch breaking should the press be tripped when the stock is not located properly in the die.

The stripper is also cut out to receive the automatic stop-finger *H*, and the four push-pin stops *J*, *K*, *L*, and *M*, which are used in starting a new strip of stock and are normally held in the non-stopping position by small coil springs. The pillars *N* are of machine steel, and are carburized, hardened, and ground. The lower ends of these pillars are made a driving fit in the die-shoe *A*, while the upper ends are a sliding fit in the reamed holes in the cast-iron punch-holder *P*, which is milled out to receive the punch pad *Q*. The blanking punch, countersinking punches, and piercing punches are all held in this pad. The blanking punch and the piercing punches are a drive fit in pad *Q*, while the two countersinking punches are a floating fit in the pad; that is, the holes in which they are located are 0.005 inch larger than the diameter of the countersinking punches. By allowing the two countersinking punches to float slightly in their holder they will be self-centering in the holes previously pierced. The tendency of the stock to stretch between and thus place a strain upon the small piercing punches is lessened by allowing the countersinking punches a certain amount of float.

In operating the die, the stock is fed to the first push-stop *J* and the press tripped, which results in two small

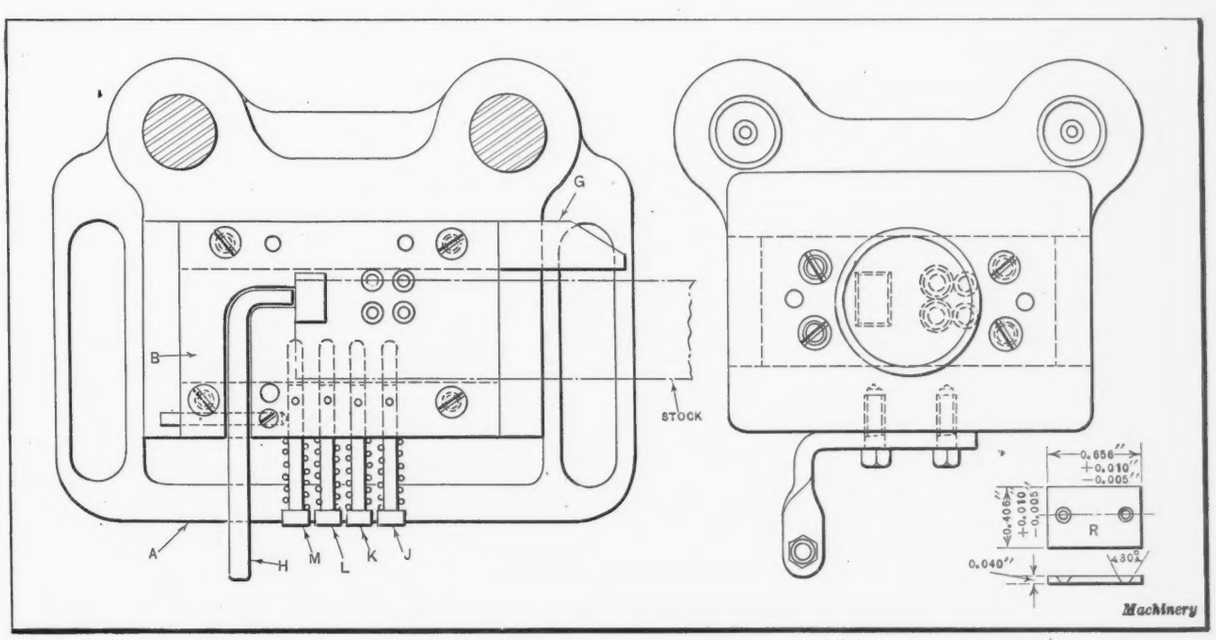


Fig. 1. Plan Views of Piercing, Countersinking, and Blanking Die and Punch

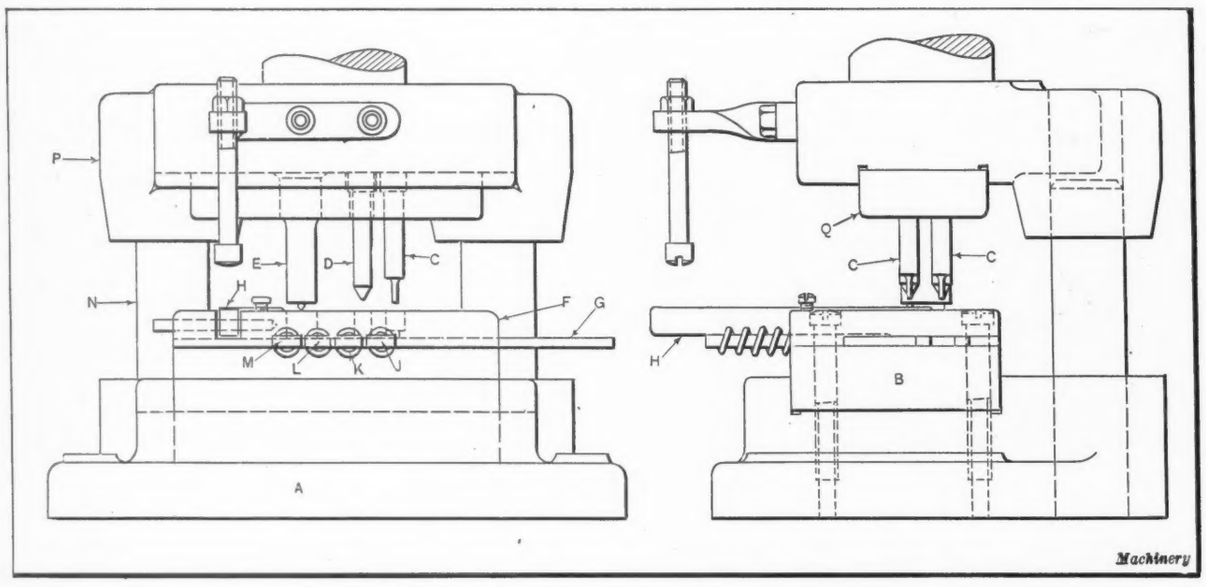


Fig. 2. Front and End Views of Piercing, Countersinking and Blanking Die shown in Fig. 1

holes being pierced by punches *C*. Then the stock is fed to the second push-stop *K*, where the two pierced holes are countersunk. At the same time two more holes are pierced in the stock. This method of locating and then tripping the press is continued until the fourth position is reached, where the first piece is blanked. The automatic stop-finger *H* then comes into use and locates the stock from the blanked opening. With this stop in operation, the press can be run continuously until the entire strip of stock has been blanked. The stock used is 1½ inches wide, so that a double run is made for each strip, a slight saving in stock being made by employing this method.

Cleveland, Ohio C. STEVENS

CUTTING METRIC THREADS WITH AN ENGLISH LEAD-SCREW

The method of offsetting the lathe tailstock and adjusting the taper attachment so that the threading tool will travel in a path parallel to the axis of the work (as employed for increasing the lead of a tap thread in order to compensate for shrinkage in hardening) may also be used for cutting odd or metric pitch threads. It is apparent that this method has some disadvantages and is not satisfactory for cutting all metric threads with standard lathe equipment. There are cases, however, in which it may be used to advantage. For instance, a request was recently received at the school shop for several hexagonal-head screws 6 millimeters in diameter, 1 millimeter lead, and 3.218 inches long over all.

The dimensions required for cutting this thread were obtained as shown in the following. First we have the lead of the screw equal to 1 millimeter or 0.0393708 inch. The lead of the nearest English thread equals 1/26 inch or 0.0384615 inch. Now the cosine of the angle to which the taper attachment is set equals 0.0384615 ÷ 0.0393708 or 0.9769. The angle which corresponds to cos 0.9769 is 12 degrees 20 minutes. Therefore the taper attachment should be set to this angle. Now in order to find the amount of offset for the tailstock, we must find the length of the base of a right triangle, the hypotenuse of which is equal to the distance between the lathe centers and which has the angle opposite the base equal to 12 degrees 20 minutes. As the sine of 12 degrees 20 minutes equals *X* divided by 3.218, we have *X* equals 0.6873 inch, which is the amount that the tailstock must be offset.

Joliet, Ill. ROSS L. MARSHALL

MILLING EVENLY SPACED KEYWAYS IN COLLARS

The fixture shown in Fig. 2 was designed for use in milling the four keyways *A*, *B*, *C*, and *D* in the periphery of collars like the one shown in Fig. 1. These collars are turned and reamed in a hand screw machine, and the keyway *E* is cut on a keyseater previous to milling the four keyways. The milling fixture, Fig. 2, has two angle-plates *F* and *G*, which are bolted to the milling machine table, and located by tongues *H*. Plates *J* and *K*, which are fastened to plates *F* and *G*, have holes through their centers the same size as the hole in collars *L*. Four keyways are cut in the plates *J* and *K*, as indicated in the view at the right-hand side of Fig. 2, to provide means for indexing the work. Shaft *M* is made long enough to hold nine collars, and is provided with a key which runs its entire length. The collars are made a push fit on the shaft. The two angle cutters *O* and *P* complete the tool equipment.

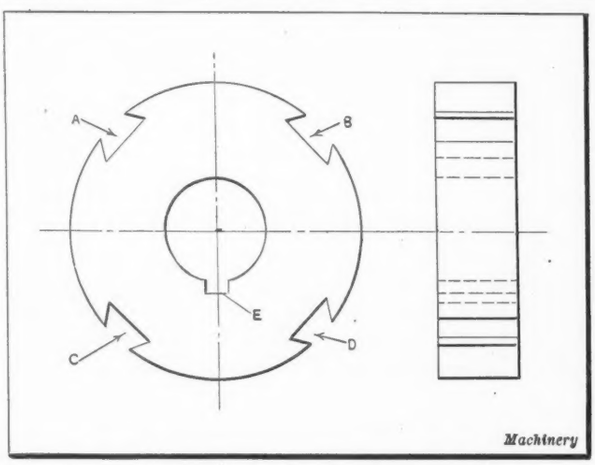


Fig. 1. Collar having Four Dovetail Slots that are cut by the Use of the Fixture shown in Fig. 2

When using the fixture, nine collars are put on the shaft *M*, which is then placed in the stationary angle-plates, as shown, the sliding angle-plate *G* being pushed toward the shaft so that the collars are held between the two plates *J* and *K*. The sliding angle-plate is then clamped down to the table, and a cut taken by the milling cutters *O* and *P*. This forms the halves of two keyways or dovetail slots. The cutters are then run back to the starting place, and the mandrel removed and given

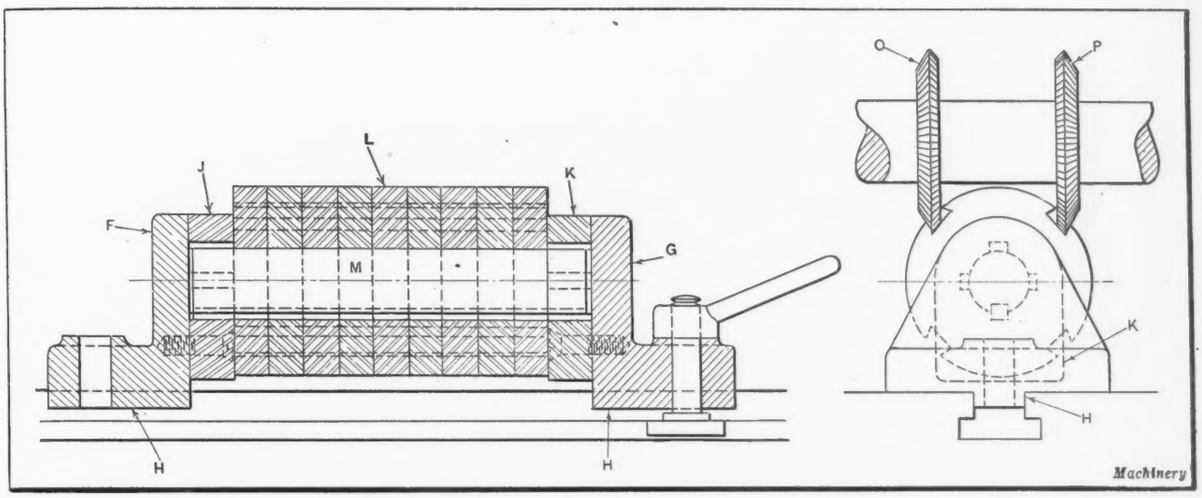


Fig. 2. Milling Fixture used in cutting Dovetail Slots in Collar shown in Fig. 1

a quarter turn so that the key in shaft *M* enters the adjacent keyways in plates *J* and *K*, after which plate *G* is again clamped in place. Another cut is then taken, and this operation is repeated until the four keyways are cut. The keyways cut by the use of this tool equipment proved to be accurate in size and correctly positioned with respect to the keyway *E*, Fig. 1.

Brooklyn, N. Y. S. A. McDONALD

KNOCK-OUT FOR COMBINATION DIE

The diagrams in the accompanying illustration show the construction of a knock-out used on a combination die. When this device is employed, the press operator does not have to remove each piece by hand. The final operation is one of forming, which makes it impossible to push the blank through the die. The view at *A* shows the knock-out device in the position that it occupies when the press ram is at the top of its stroke. At *B* the device is shown at the beginning of the down stroke, and at *C* the knock-out is shown as it appears at the end of the downward stroke. The view at *D* shows the position of the knock-out at the beginning of the upward stroke when the kicker or pusher *F* has just ejected the part from the die.

Referring to the view at *A*, it will be seen that the die *E* has an angle-piece *P* attached to its base which carries the trigger *F*. The trigger is pivoted at its lower end, while the upper end swings in a groove in the die *E*. The back end of trigger *F* carries a roller *H*, which rests in a pocket in the sliding piece *J*; part *J* is dovetailed to part *K* (see sectional view *G–G*) so that it slides freely. Part *K* is fastened to the punch-holder, and carries the pins *L* and *M*. Pin *L* comes in contact with part *J* on the down stroke, and pin *M* comes in contact with the lower edge of this part on the up stroke of the press. A spring (not shown) serves to hold trigger *F* in the forward position so that the pressure of the roller against *J* will sustain this part while part *K* descends with the punch-holder.

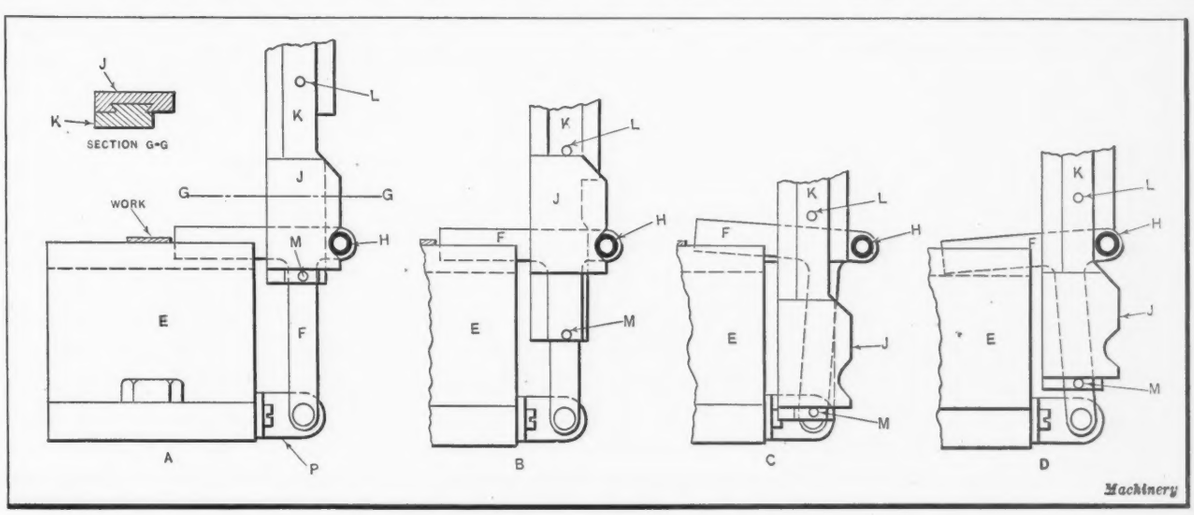
When the knock-out is in the position shown in the view at *B*, the press ram is approximately at the center of its down stroke. It will be noted that the sliding piece *J* has been kept in position by the pressure of the roller *H* in the pocket. At this point pin *L* makes contact with the upper end of *J*, and as the ram continues to descend, it carries part *J* along with part *K* so that roller *H* rides out of the pocket and along the outer edge of *J*.

When the ram has reached the bottom of its stroke, roller *H* has run off the edge of part *J*, which then drops by gravity, allowing roller *H* to rest on the back edge of part *K*. As the ram ascends, roller *H* drops into the depression in *K*, causing trigger *F* to strike the work and eject it from the die. Pin *M* causes part *J* to be carried along with part *K* on the upward stroke of the ram, so that roller *H* rides up the incline on the upper end of part *J* until at the top of the stroke roller *H* again drops into the pocket in *J*.

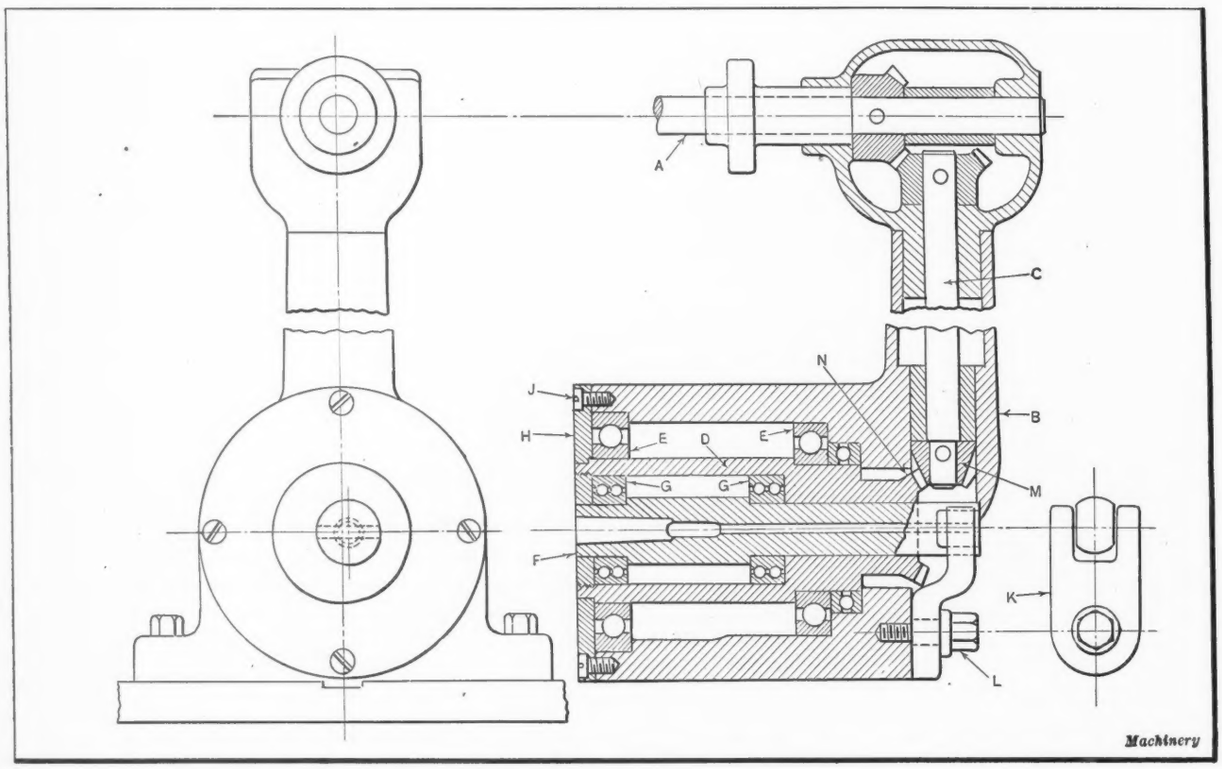
Philadelphia, Pa. R. H. KASPER

ECCENTRIC DRILLING FIXTURE

Certain parts machined on turret or automatic lathes in large quantities are required to have a hole drilled in one end which is located slightly eccentric with respect to the



Diagrams showing Successive Positions of Knock-out used on a Combination Die



Turret Lathe Fixture for drilling Offset or Eccentric Holes

center of the part. The drilling attachment shown in the accompanying illustration was designed for use in drilling such eccentric holes while the work is held in a turret lathe chuck in the same position it occupies when being turned.

The attachment is fixed at one of the tool positions of the turret, and is driven through a shaft *A* from the head of the turret lathe. The main housing *B* supports the vertical bevel pinion shaft *C* and the driving shaft *A* at the turret end. The main spindle *D* runs in ball bearings *E* and is bored eccentric, the amount of eccentricity or offset being determined by the part to be drilled. Spindle *D* is driven by shaft *A* through the bevel gears *M* and *N*, the latter being cut on the end of spindle *D*. The drill spindle *F* is kept in place within the main spindle by ball bearings *G* and the front retaining plate *H*. Plate *H* also serves to retain the main spindle in the housing, and is held in place by screws *J*.

The drill spindle *F* has a hole running its entire length which permits the drill to be pushed out by means of a rod. A flat is machined on both sides of the rear end of spindle *F* so that it will engage the square slot in the lever *K*. Lever *K* thus prevents spindle *F* from rotating within spindle *D*. However, this lever is free to swing on its pivot stud *L* with the motion of the drill spindle when the latter moves about the center of the main spindle *D*.

The work and spindle *D* must, of course, revolve at the same speed. The carriage-feeding mechanism is employed to feed the drill into the work, the rate being governed by the size of the hole and the quality of work required. If there are several pieces of work of varying eccentricity, the main spindle may be bored to accommodate the drill spindle for the maximum offset, and additional drill spindles for the different jobs may be provided with bushings.

Springfield, Vt. O. S. MARSHALL

SHRINKAGE CRACKS IN CAST-IRON WHEELS

Apprentice patternmakers often wonder why machine-building companies that have been in business for years continue to send out machines or equipment with cast-iron parts that are heavy or clumsy in appearance. In most cases, however, there is some good reason for not changing or improving the appearance of such parts by redesigning the pattern. Perhaps one of the most common reasons for using castings that appear unnecessarily heavy or clumsy for their purpose is the difficulty of avoiding shrinkage cracks. This was the case with the wheel shown in Fig. 1.

The heavily constructed truck wheel shown in this view is 15½ inches in diameter and has a web at the center in which there are six holes. The narrow section between the holes is reinforced with ribs on each side of the web. In the center is a hub that is cast solid without a cored hole. This may be considered unusual in a casting of this kind. However, the metal is so equally distributed that no trouble is experienced from shrinkage cracks.

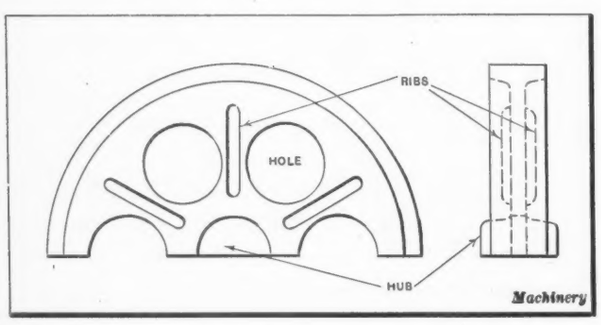


Fig. 1. Cast-iron Truck Wheel as originally designed

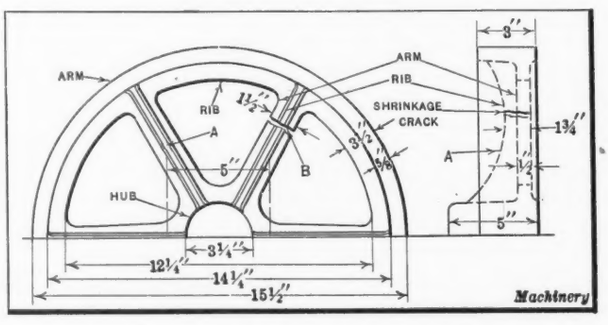


Fig. 2. Redesigned Truck Wheel which had Shrinkage Crack at B

As the pattern for this casting had become lost, it was necessary to make a new one. In making the new pattern, it was decided to change the design so that the wheel would have a neater appearance. The new design, shown in Fig. 2, has six T-shaped spokes or arms and a rib on the inside of the rim. The arms and rib are the same thickness. The rib *A* is 3/8 inch thick at the bottom, 3/16 inch thick at the top, and is curved as indicated in the view at the right-hand side. The pattern was made with sufficient taper to allow it to be easily drawn from the mold. However, the castings produced from this pattern had shrinkage cracks in one arm, as indicated at *B*, which is the weakest section in the casting. As the hub was cast solid, it cooled very slowly and continued to cool and contract for some time after the arms had cooled and become set. Consequently, the casting was forced to break at the weakest section. The coring of a hole in the hub resulted in a more even distribution of metal and eliminated the shrinkage cracks.

Kenosha, Wis. M. E. DUGGAN

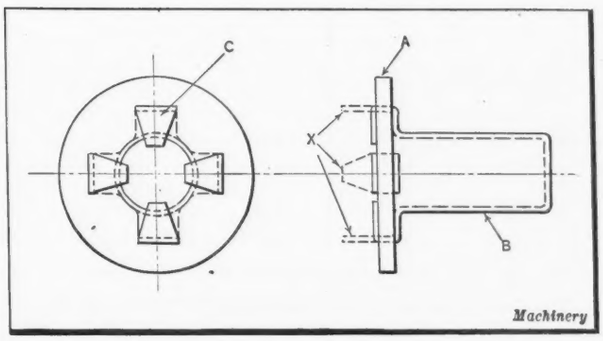


Fig. 1. Part assembled by Means of the Punch and Die shown in Figs. 2 and 3

FOUR-SLIDE ASSEMBLING DIE

In order to manufacture the part shown in Fig. 1 on an economical basis, it was necessary to design a quick-acting tool for assembling the ring *A* on the drawn brass sleeve *B*. In assembling these parts, the four prongs on sleeve *B* are passed through notches in the ring *A* and then bent over into the position shown by the full lines at *C*. The dotted lines at *X* show the position of the prongs before being bent over. This assembling operation was satisfactorily accomplished on a punch press equipped with the punch and die shown in Figs. 2 and 3.

In the die shown in Fig. 2, the sleeve or stem *B* of the work is put in a hole, with the closed end resting against the lever *W*, which is pivoted at *C* and prevented from being further depressed by the surface *D*. The sleeve *B* is put in place with the ring *A* over the prongs, the ring resting in the recess in the steel block *F*. In block *F* are four slides *G* which have beveled ends at *H*. These slides are retained in the slots by plate *J*, which is held in place by screws *K* passing through block *F* and entering the base *L*.

The construction of the punch is shown in Fig. 3. The four beveled plungers *N* are attached to the holder *M*, and the steel ring *P* is attached to the center of holder *M*. Springs *Q*, Fig. 2, normally hold slides *G* back about ½ inch from the position in which they are shown so that the stem *B* of the work with the ring *A* in place may be put in the die. The size of the opening in the die is controlled by pins *R*, which enter elongated slots *S* in the slides and limit the outward movement of the slides. As the punch descends, the beveled plungers *N* come in contact with the beveled surfaces *H* on the slides *G*, thereby driving them into the position shown. This action forces the four prongs of the work over, so they clinch the stem on the ring.

A slight amount of play or looseness is allowed in the slides. The disk *P*, Fig. 3, which is attached to the punch strikes the top surfaces of the slides *G*, thus pressing the prongs of sleeve *B* more tightly against the ring *A*. As the punch ascends after completing this operation, the slides *G* are opened or moved outward by the action of springs *Q*. The operator then presses down on the end *T* of lever *D*, which pivots about *C* and thereby raises the work so that it can be removed from the die and a new piece put in place. As the end *D* of the ejecting lever is much longer

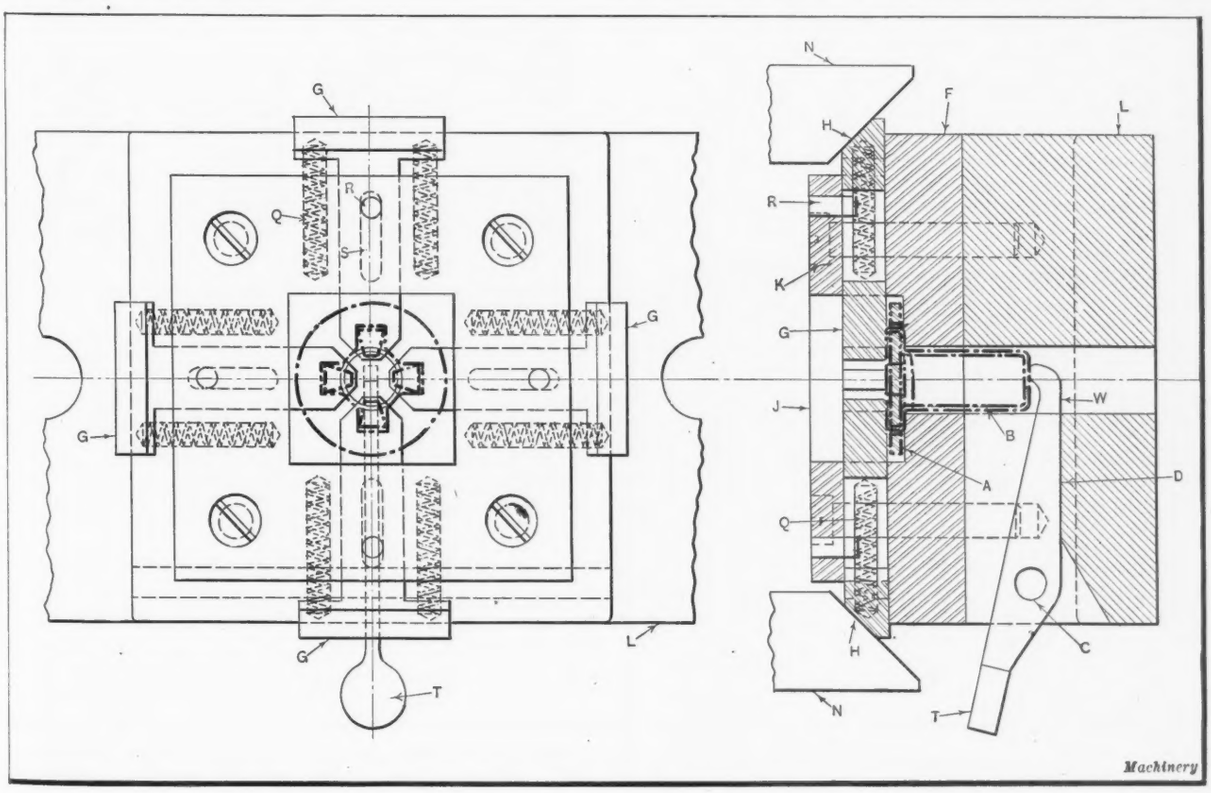


Fig. 2. Die used in Connection with the Punch shown in Fig. 3 for assembling Parts shown in Fig. 1

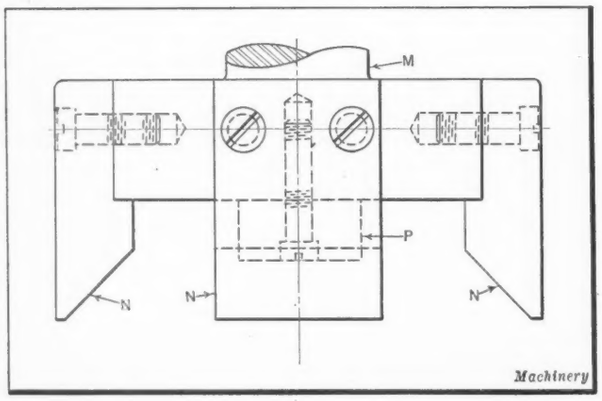


Fig. 3. Punch used in assembling Parts shown in Fig. 1

than the opposite end, its greater weight has a tendency to hold the lever in the position shown, so that it does not interfere with the insertion of the work in the die.

F. SERVER

USING A BREAST DRILL FOR LIGHT TURNING AND GRINDING

It is possible to use the spindle of a breast drill in place of a lathe spindle for light turning and grinding operations, if the frame of the drill is secured to the bench. A simple angle-iron or bracket made from a piece of iron or steel, ¼ inch thick by 3 inches wide, forms a convenient means of securing the breast drill to the bench. With most types of breast drills it will be found best to bend over the top end of the angle-iron so that it forms a ledge on which the upper side of the drill frame can rest. The tapped hole left in the side of the frame after the side handle has been removed can be used for bolting the breast drill to the bracket. The hole in the bracket through which the fastening bolt passes should be so located that the upper side of the breast drill frame will be in contact with the ledge or bent-over end of the bracket.

A simple chuck for holding work or drills of a diameter larger than the ordinary chuck or drill will accommodate, may be made by threading four equally spaced set-screw holes at one end of a collar and cutting a thread at the opposite end of the collar which will fit the threaded end of the drill spindle. Either a piece of work or a drill can be properly centered in this chuck by carefully adjusting and tightening the four set-screws.

Washington, D. C. GEORGE A. LUERS

ADJUSTABLE MANDREL FOR LOCOMOTIVE CROSS-HEAD

The adjustable mandrel shown at *A* in Fig. 2 provides a means of quickly mounting locomotive cross-heads on a planer table for machining operations, as illustrated in Figs. 3 and 4. The mandrel body *A*, Figs. 1 and 2, is made of a tough machine steel. The cones *B* and *C* are made of steel and are casehardened. They are tapered, as shown, so that cross-heads having a piston fit of any size and taper that is likely to be encountered in regular repair shop work can be easily and quickly secured in place for the machining operations. The cone shown at *C*, Fig. 1, can be used to hold any cross-head having a tapered hole from 3 to 4 inches in diameter. If larger sizes are likely to be met with, another set of cones of larger size can be made up and used on the same mandrel.

If the mandrel is kept secured to the back end of the planer table in V-blocks like the ones shown at *D* and *E*, Fig. 2, it will always be ready for rush jobs or running repairs on locomotives. With this arbor and the writer's patented planer tool shown at *F*, Figs. 3 and 4, only about thirty minutes is required to complete the planing operations on a locomotive cross-head. To set up a cross-head

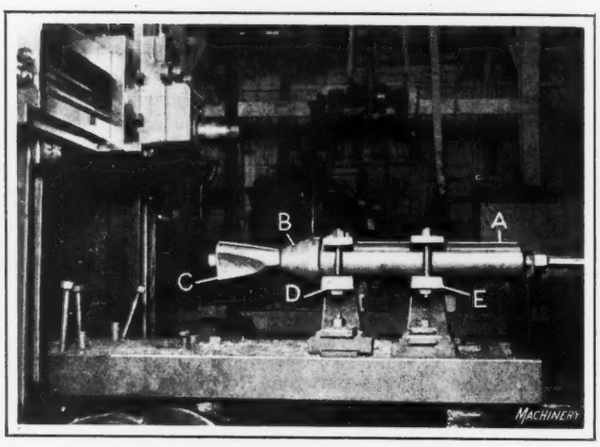


Fig. 2. Mandrel mounted on Planer Table

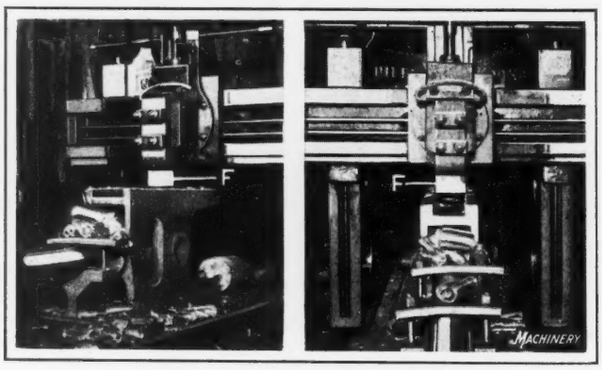


Fig. 3. Set-up for planing Locomotive Cross-head

Fig. 4. Front View of Set-up shown in Fig. 3

for planing, the rod *R* and the cone *C*, Fig. 1, are first removed from the mandrel. The cross-head is then placed on the end of the mandrel so that it is in contact with cone *B*, after which cone *C* and rod *R* are replaced, and the nut *G* tightened. This secures the cross-head firmly in place, and insures accurate alignment.

St. Elmo, Tenn. H. H. HENSON

* * *

A year ago, fifteen months were required for initial action by the U. S. Patent Office on an application for a patent. Now the maximum time is nine months, due to the increased facilities that have been provided. Realizing the great importance to industry of further speeding up the work of the Patent Office, Congress has authorized an appropriation which will permit an addition of 100 examiners to the present force of 500. The Patent Office receives annually about 80,000 applications for patents. Of all the patents granted in the world, about one-third have been issued by the Government of the United States.

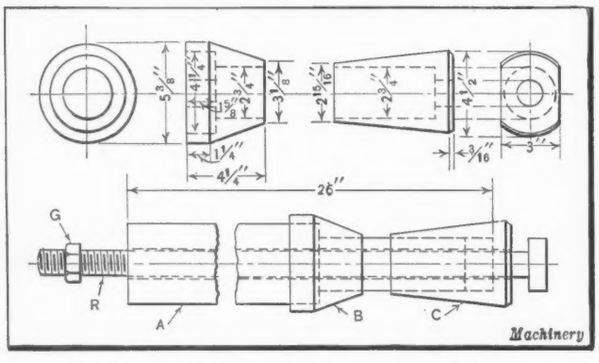
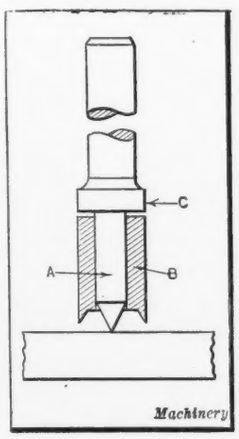


Fig. 1. Adjustable Mandrel for Locomotive Cross-head

Shop and Drafting-room Kinks

CENTER-PUNCH WITH SPACING COLLAR

The centering punch shown in the accompanying illustration consists of two parts, the central member or punch *A*, and the spacing collar *B*. The punch is made from a piece of ½-inch drill rod turned down to a diameter of ⅜ inch above the collar *C*. This collar is left ½ inch in diameter, but the section below it is turned down to a diameter of ¼ inch.



Center-punch provided with Spacing Collar

Collar *C* has a good bearing surface on the spacing sleeve or collar *B*. The spacing collar is made a sliding fit on the lower section of punch *A*, and is about 1/16 inch shorter than the distance from the point of the punch to the under side of collar *C*. This allows the point of the punch to enter the work to a depth of about 1/16 inch before the sharp edge of collar *B* makes an impression on the surface of the work. This punch has been found very useful in laying out templets, and very accurate spacing can be obtained by using a collar *B* which is machined accurately to size. The writer has a punch of the size described, provided with six different spacing collars ranging from 5/16 to 5/8 inch in diameter, which has proved very useful.

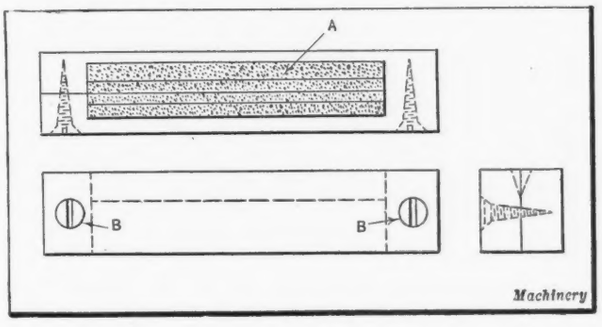
Garwood, N. J. FRANK SHIMPFLE

PENCIL POINTER

A small device for use in making a fine point on a pencil lead after the pencil has been sharpened in the regular way, is shown in the accompanying illustration. The pointing device is simply a small block of wood with a V-groove formed in the center as shown. The angle of the groove should be a little greater than the angle of the pencil point formed by the regular rotary sharpener. The block of wood is cut exactly in half along the center of the V-groove and a piece of sandpaper or fine emery cloth *A* glued to each side of the groove and allowed to extend to the bottom of the wooden block.

The two halves of the wooden block are fastened together by the wood screws *B*. In using this pointer, the block is held firmly on the desk or table by one hand, while the other hand holds the pencil in a vertical position with the lead point resting in the groove. By moving the pencil from end to end of the V-groove and twirling it at the same time with the finger tips, a fine point will be produced after four or five strokes have been made.

Trenton, N. J. EDWARD W. LARUE



Device for producing a Fine Point on a Pencil Lead

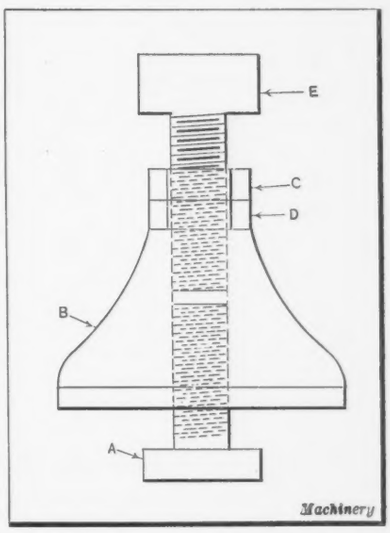
TRUING UP CHUCK JAWS

The following is a simple method of truing up the jaws of a universal chuck with a center grinder. A piece of pipe of large diameter is first put on the outer steps of the chuck jaws. After tightening the jaws against the inner surface of the pipe, the center grinder is used to grind the inner ends of the chuck jaws, which are generally used to grip small round work. A piece of pipe of small diameter is next gripped in the trued-up jaws and the outer steps ground true. The center grinder is, of course, held in the toolpost, and the lathe spindle speeded up when grinding.

Denver, Col. R. M. THOMAS

FACING RINGS IN A BORING MILL

Having a large number of flat rings varying from 30 to 46 inches in diameter to be machined in the boring mill, the writer devised the following method of supporting the rings while facing the sides. The sides of these rings were required to be parallel within 0.001 inch, which made it necessary to employ an accurate means of locating and holding the rings on the boring mill table.



Jack used to support Work on Boring Mill

Four jacks like the one shown were used. These were fastened to the boring mill table between the chuck jaws by placing the lower screw *A* in the T-slot and screwing down the body *B* of the jack which served as a nut. Body *B* is of cast iron, and is hexagon-shaped at the upper end *D*, so a wrench may be used to tighten it. After adjusting the upper studs *E* of the jacks to a little above the chuck jaws, nut *C* was tightened and a light cut taken over the top surfaces of studs *E* so that they would provide four accurate surfaces on which the work could be located.

Massillon, Ohio GEORGE R. CASTER

OVERHEAD CORD FOR PORTABLE DRILL

It is not uncommon to see the extension cord of a portable electric drill all tangled up in a knot. Frequently it is dragged over the floor or left where it is sure to be stepped on, and possibly covered with castings or machine parts. Of course, a cord that is subjected to such treatment cannot be expected to last very long. This condition can be avoided, however, by providing an overhead supporting wire, as described in the following: A ¼-inch wire is strung up above the positions where the drill is to be used. This wire can be drawn tight by means of turnbuckles. A number of steel rings are placed on the wire so that they can be slid along its entire length. The extension cord is attached to these rings, leaving about a 3-foot space between them. Lead weights are then attached to the cord between the rings in order to keep it in position below the wire.

Cicero, Ill. JOHN J. BORKENHAGEN

The Machine-building Industries

FOR more than a year now the pessimists and the fearful have foreseen a serious depression in business. Last spring we were told that it was due in the fall. The fall arrived with a slackening in business—compared with the spring boom in the steel, automobile, and railway rolling stock fields—but the slackening was slight and in some fields production was greater than ever before at that time of the year. Now we are told by the same undaunted prophets that we will have dull business next fall. The presidential election, it is said, is going to have a serious effect; and right now the oil lease investigation is likely to affect business adversely. Meanwhile, 110,000,000 people will continue to consume food, and wear clothing, and live in houses, and ride in automobiles, and use the thousand and one things that industry produces. And as there are no considerable stocks of goods of any kind in existence, employment in general is likely to continue at the present satisfactory rate. With wages as high as they are, consumption will go on, and no serious falling off in production can reasonably be anticipated unless doubt and fear take possession of those who control the business mechanism. Conservatism and caution should not be discouraged: Caution keeps the business machine under control and regulates the speed, but fear puts on the brakes and jolts the passengers.

Now, what are the actual facts relating to general business conditions? February production, as reported by the Department of Commerce, covering sixty-five commodities, was 17 per cent higher than the average production in the boom year 1919, 13 per cent higher than in December, 1923, and shows a slight increase over a year ago. Pig iron production was 20 per cent higher in February than the 1913 average, the largest pre-war year. It also showed an increase over February a year ago, which ushered in a boom period in the iron and steel field, and it was higher than in January this year. The production of steel ingots was 50 per cent higher than the 1913 average, and showed also a substantial increase both over February a year ago and over January this year.

It is true that the unfilled steel orders are less than they were a year ago, but they show an increase over the previous month. The same is true of the unfilled orders for locomotives, which, at the end of February, were 30 per cent greater than at the end of January. The operations of the steel casting foundries rose 20 per cent in February as compared with January, and were the highest since last June. Malleable casting foundries also show an improvement over the last months of the past year. Incidentally, there was a slight increase in the prices of farm crops, which will ultimately reflect itself in the increased purchasing power of a class that constitutes one-half the population of the United States.

The Machine Tool Industry

In the machine tool industry, the picture is not quite so bright as in the general manufacturing field. Business in January was generally better than for many months past, but since then it has again fallen off, although the orders booked in February were higher than the average for the last four months of the past year. A volume of business similar to that of last year can reasonably be expected, mainly for replacement purposes, and in machines of improved productive capacity. It is quite evident that in the standard lines of machine tools it is the newer, redesigned types that sell the best, even in spite of the fact that they are usually somewhat higher in price than older models.

The best that can be said for business in the machine tool field is that it is "spotted." We find three or four lathe builders quite well occupied; and in the bench lathe field one concern is running to capacity, while another reports that business is better than it has been for the last three years. However, others in the same line still find business limited. In planers, three concerns have a very satisfactory volume of business, while others are unable to operate their plants to anywhere near capacity. Drilling machines are quiet, except for a fairly active demand for certain types of radial and sensitive drills and high-production machines. In the grinding machine field, the most active demand is for face grinders, while universal and cylinder grinders are less active.

Small Tools and Accessories

In the small tool field, it is probable that the present production must be considered "normal," although the productive capacity of the industry is considerably in excess of the demand. In the tap industry, for example, production is about from 25 to 30 per cent in excess of the 1913 output; this percentage, if based on the value in dollars and cents, is, of course, considerably higher. This volume of business, however, does not engage this industry to more than about two-thirds of its capacity. The broach industry is fairly active, and will remain so as long as automobile production is maintained. About 75 per cent of the output of the broach shops goes directly or indirectly to the automobile-building plants. In wrenches and similar accessories, domestic business is practically normal, and machinists' measuring tools and micrometers are in considerable demand, especially in the automobile manufacturing districts. Both the industrial and the automotive chain plants are, on the average, producing more than at any time for the last two years. In this field, new business coming in indicates confidence in continued activity in many branches of the machine-building industry.

The Iron and Steel Industry

The iron and steel business has continued to gain during the past month, and has now reached the highest point since last fall; meanwhile, the unfilled orders on the books of the steel plants have been accumulating. New business calling for large tonnage is continually being placed, and according to the Federal Reserve Bank of Cleveland, in which district, with a few exceptions, most of the important steel plants in the country are located, the present outlook is promising and active business is assured up to the middle of the year, at least. Some of the mills of the United States Steel Corporation are operating at 100 per cent capacity, and the corporation as a whole operates at between 93 and 94 per cent. The rail mills are pressed for deliveries, and it is estimated that the railroad orders amount to about 30 per cent of the business on hand.

In spite of the increased production, there has been no tendency so far toward increases in prices. It is relatively easy to obtain materials, and because of the ample transportation facilities available, buying is not done very far ahead; hence, while orders on hand at the mills are less than they were a year ago, it is likely that actual consumption will be just as great. Generally speaking, conditions in the iron and steel trade are unusually healthy.

Taking the entire business situation into consideration, there is nothing disquieting at the present time, so long as the leaders in industrial fields do not permit themselves to be unduly influenced by the political situation.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Williams Portable Pipe-threading, Cutting and Reaming Machine

A NEW portable pipe-threading, cutting-off, and reaming machine which is marketed under the trade name of "Willie Williams," has been brought out by the Williams Tool Corporation, 12th and Liberty Sts., Erie, Pa. The principal features of this machine are that it is portable, demountable, provided with a self-contained grinder, and has three drives—motor, belt, and hand, built right into the machine. A unique feature of the machine is the fact that it can be converted into a power unit in 2½ minutes, and by using a flexible shaft it will operate hand stocks up to and including 8 inches.

The weight of the machine, complete with motor and all standard parts, is only 520 pounds, so that it is easily moved to any part of the shop or taken out on the job where the work is to be performed. It is so designed that it can be "knocked-down" in 2 minutes and 30 seconds, and reassembled in less than 4 minutes. The pressed-steel oil trough and cutting pan under the carriage can be lifted off, allowing the carriage and head to slide off the ways. The latter, which are made of seamless steel tubing, can also be pulled out of the headstock, by slackening two screws, thus leaving only the pedestal and headstock as a unit which two men can easily lift and move to any desired place.



Fig. 1. Williams Pipe-threading, Cutting, and Reaming Machine

The motor is standard, one horsepower, mounted on a hinged table in the base of the machine, and the power is transmitted by belt to the flanged driving pulley of the machine. A demountable hand crank, located in a suitable position for the operator, is used for raising the motor to release the belt and stop the machine. Automatic adjustment is provided to compensate for stretching of the belt. Any unusual strain on the dies will cause the belt to slip instead of ruining dies and motor. When it is desired to stop the machine, to change pipe or inspect threads, the lever can be thrown over and locked. This eliminates the necessity of shutting off the current. Fifteen feet of extension cord with plugs is furnished with each machine, which enables the operator to connect with the ordinary lighting circuit.

The machine can be converted to belt drive by simply removing the motor belt and driving directly from a line-shaft or countershaft. Provision is also made for operating the machine by hand. In order to do this, it is only necessary to shift the gears to a neutral position, when the demountable crank handle can be fitted directly to the worm-shaft, which is direct-connected to the spindle through a worm and worm-wheel with ball thrust bearing which operates in oil.

The capacity of the machine makes it possible to cut either right- or left-hand threads on pipe from ¼ inch to 2 inches, and on bolts from ⅜ inch to 1½ inches, inclusive. The cutting-off capacity covers the same sizes of pipe and bolts. The machine will ream the inside and chamfer the outside of pipe from ¼ inch to 2 inches, inclusive. The longest run of thread at one chucking is 10½ inches.

The spindle has two speeds arranged in a manner similar to automobile sliding gears, which also provides for a neutral position, so that the spindle may be started and stopped without shutting off the current. All gears are made of steel, machine cut, heat-treated, and run in oil. The long hard babbitt bearings are provided with a self-oiling system. The spindle is made of extra heavy seamless steel tubing. It has a 2⅞-inch bore, which allows a 2-inch coupling to pass through it.

The front gripping or driving chuck is of the Williams standard three-jaw universal self-centering type. On the rear of the spindle is a standard Williams three-jaw self-centering scroll chuck for centering long lengths of pipe. This is operated by a handwheel. The carriage ways on which the carriage slides are of extra heavy seamless steel tubing. They are ground to size and highly polished. The way nearest to the operator has gear teeth milled on its surface, which engage a pinion shaft for operating the carriage. The die-head and carriage are cast in one piece, thus eliminating any possible chance of the head getting out of alignment. The carriage has six bearings on the ways, three on each side, lined with hard babbitt

The dies are interchangeable and operated by cam and lever. A graduated die-head makes unnecessary the use of blank gages for setting the dies. Whenever several pieces of the same size are to be threaded, a cam stop is used to set the cam lever at the right place for this particular size. The dies expand far enough to permit a pipe with coupling to pass through to the cut-off tool, without touching the dies. Four sets of dies are furnished with the machine as standard equipment, one set cutting 1/4 and 3/8 inch; the second, 1/2 and 3/4 inch; the third, 1 and 1 1/4 inches; and the fourth, 1 1/2 and 2 inches. To change the dies, it is only necessary to loosen two nuts on the face of the die-head, so that the die plate can be shifted slightly and lifted right away from the head.

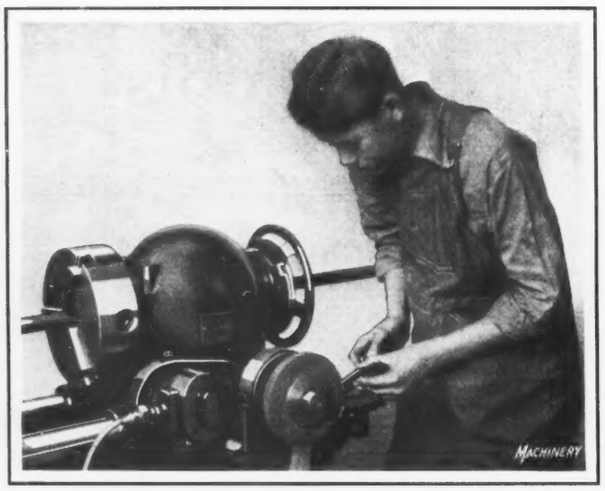


Fig. 2. View of Machine showing Emery Wheel provided for grinding Dies or Tools

The cut-off attachment is mounted on the rear of the die-head and operated by a screw and handwheel. A V-block equipped with hardened tool-steel facings steadies the pipe when cutting off. The cut-off blade is a double-beveled high-speed steel tool, set at an angle which gives a natural clearance when cutting off all sizes, allowing the machine to run at high speed for all cutting off. On the cut-off attachment is pivoted a reamer-holder operated by a lever. The tool bit used for reaming and chamfering is 5/16 inch square high-speed steel, the same as is used in most standard tool-holders.

A rotary geared oil-pump is located on the rear side of the machine, gear-driven directly from an intermediate shaft. The oil is pumped from a reservoir in the base of the machine and passed through a strainer to the pump. From there it is forced through a flexible hose to the die-head, where a three-way valve enables the operator to regulate the flow of oil for the dies and cut-off tool. After flushing the dies and cut-off tool, the oil drains back into the oil- or chip-pan under the die-head, and is then strained before it flows back into the reservoir, from where it is again pumped through the system.

A special feature of this portable machine is the high-speed emery wheel which is mounted on the pulley shaft at the rear of the machine as shown in Fig. 2, and driven directly from the motor. The wheel is set at such a height above the floor as to be most convenient to the operator. Users of pipe machines will find this added feature of considerable convenience. Any simple grinding on a die or tool can be quickly done. The machine is so designed that when the operator uses the emery wheel, no other part of the machine is running except the motor and wheel, giving him the full power of the motor for grinding purposes. The wheel runs at about 1100 revolutions per minute. It is 6 inches in diameter, with a ¾-inch face, of the proper grade for general grinding purposes. A special die cabinet is cast in the top of the pedestal, providing a safe and convenient place for storing dies as well as any other small tools used on the machine.

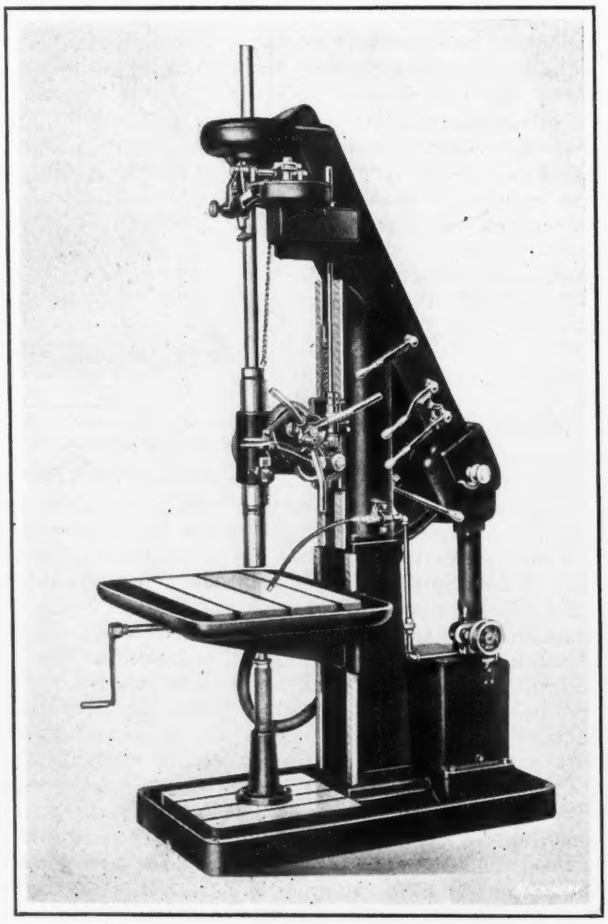
BARNES DRILL CO.'S SELF-OILED DRILLING AND TAPPING MACHINE

A new No. 263 sliding-head self-oiled all-geared drilling and tapping machine designed for production work has been brought out by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill. This machine is similar to the 26-inch sliding-head all-geared drilling machine and has the same swing, but it embodies some improved and patented features. One of the main improvements in the new machine is the provision of a self-oiling system, by means of which all the driving shafts are continuously and automatically lubricated. All shafts in the speed-change transmission, including the drive shafts, are mounted in radial ball bearings, the crown gears also being mounted in ball bearings.

The machine is of the all-geared type as mentioned no slip gears nor cone belts being employed. The customary worm and worm-gear feed has been eliminated and a spur gear feed substituted, which permits feeds as fine as 0.005 inch per revolution of the spindle to be employed. Another new feature of this machine is the method of attaching the rack to the spindle sleeve; instead of employing screws and dowels, which cause trouble by working loose, the rack is dovetailed into the sleeve and keyed to it so that it cannot work loose. Eight changes of both speeds and feeds are provided, and any speed or feed can instantly be obtained without stopping the machine.

The automatic reversing mechanism provided on this machine is a particularly desirable feature for depth tapping. The trip can be set so that the instant the tap reaches the required depth, the spindle will automatically reverse, backing out at an increased speed. When it is desired to stop the spindle instead of reversing it, the shifting lever can be set so that when tripped it will automatically return to the neutral position. A small hand-trip lever is provided for reversing or stopping the spindle at any point.

This machine handles high-speed twist drills up to 2½ inches in diameter at suitable speeds and feeds. It has a capacity for boring cylinders up to 8¼ inches in diameter. The machine has been in service for many months drilling 1¼-inch holes, 5 inches deep, in automobile forgings at the maximum working speed and feed of the high-speed twist drill used, with no breakage of the hardened steel spur feed gears and no damage to any other parts. Two styles of machines are furnished, one having a square column and large rectangular table as shown in the illustration, and the other a round column and table.



Barnes Drill Co.'s All-geared Drilling and Tapping Machine, provided with a Self-oiling System

BROWN & SHARPE UNIVERSAL GRINDING MACHINE

The Brown & Sharpe Mfg. Co., Providence, R. I., has brought out a new universal grinding machine of the constant-speed drive type, known as the No. 2-I universal grinding machine. Containing all the features of the regular Brown & Sharpe line of universal grinding machines, this new machine possesses, in addition, the advantages of a constant-speed self-contained style of drive. Incorporated in the design of the machine are also many of the features of the company's line of plain grinding machines, such as independent automatic cross-feed, quick traverse of the wheel-slide, and all-geared change speed and feed mechanisms. The automatic lubrication of the various operating mechanisms is a new feature. The machine takes work 14 inches in diameter by 36 inches in length, and swings 12½ inches in diameter over the water guards.

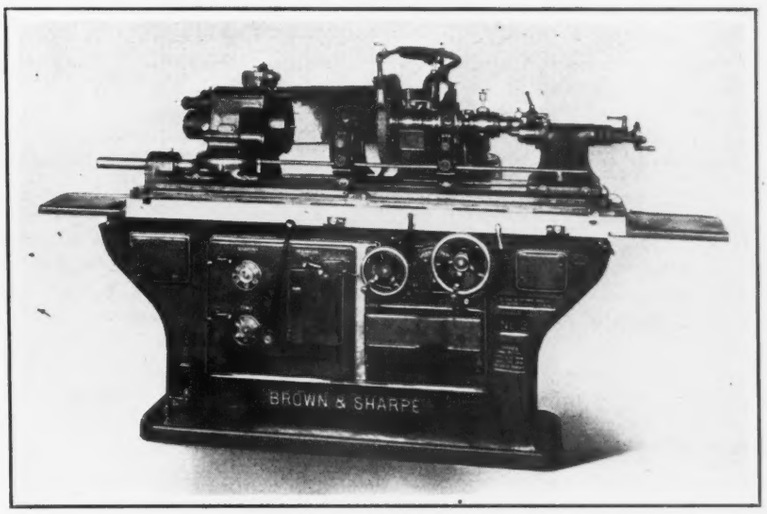


Fig. 1. Brown & Sharpe Universal Grinding Machine with Constant-speed Drive

The table and work are controlled by the hand-lever shown slightly to the left of the center of the machine in Fig. 1. The same lever also actuates a brake for stopping the table and work. The various other controls are placed conveniently at the right and left of the operator. The constant-speed self-contained drive consists of a single pulley, 8½ inches in diameter for a 4½-inch belt, protected by a heavy belt guard. The driving shaft runs in ball bearings at a constant speed of 900 revolutions per minute. This arrangement dispenses with a great deal of overhead shafting and belts, and makes the machine adaptable for motor drive. Provision is made for a motor drive, and when so arranged, the motor is fastened to the floor and drives the pulley by means of a belt.

At the rear of the machine, on the main driving shaft is the wheel driving pulley, the face of which is made exceptionally wide to compensate for the varying position of the wheel-slide. From this pulley the grinding wheel spindle is driven by a belt running over horizontal idlers, mounted on roller bearings that are carried in a swinging frame, and vertical idlers mounted on the wheel-stand. The swinging frame automatically provides for keeping an even tension on the belt, regardless of the position of the wheel-spindle. An adjustment is also provided for taking care of the stretch of the belt. Split pulleys of different diameters are used to obtain the various wheel speeds.

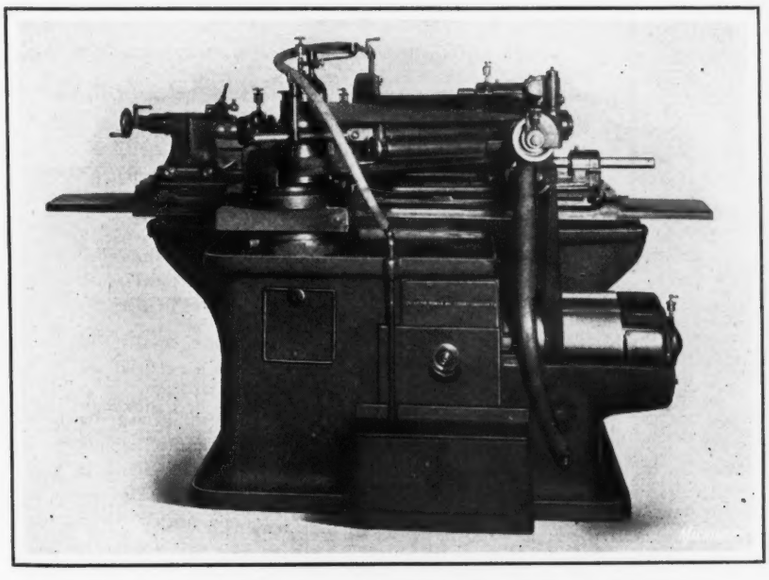


Fig. 2. Rear View of the Machine, showing the Belt Drive to the Wheel-spindle

An oil pump and tank, contained within the base, furnish a constant supply of lubricant, which is conveyed by means of pipes directly to the various mechanisms, flooding the operating mechanisms. After being used, the oil is returned to the tank. Bearings not automatically lubricated are provided with sight-feed oilers or grease cups. The oil is automatically shut off when the table-operating mechanism is not functioning.

The wheel-spindle is made of alloy steel and runs in hardened, ground, and lapped bearings, with self-aligning bronze boxes provided with means of compensating for wear. It takes a wheel with a maximum diameter of 14 inches, ¾ to 1½ inches thick. The wheel is easily removed and is amply guarded. The wheel-slide swivels, and the angle of setting of the wheel-slide is measured by graduations on the base. In addition, the wheel platen can be swung to a maximum angle of 10 degrees. This feature enables the operator to grind two different tapers at one setting.

The hand cross-feed and quick traverse are operated by a handwheel located on the front of the machine. This handwheel has two positions—one engaging the hand cross-feed and the other disengaging the hand cross-feed and engaging the quick traverse. The automatic cross-feed has a range of feed of 0.00025 to 0.004 inch upon each reversal of the table. It can be set to automatically throw the feed out of operation as soon as the work has been reduced to the desired diameter. The wheel is fed to the work, while the table remains stationary, by means of the independent automatic cross-feed. At such times the table can be securely locked from traversing by a safety lock which prevents the engagement of the longitudinal feed.

The speed of the wheel, the speed of the work, and the feed of the table are entirely independent. They consist of four changes of wheel speed, furnishing a range of from 1500 to 2400 revolutions per minute, twelve indicated changes of work speed of 24 to 492 revolutions per minute, and twelve indicated changes of table feed that can be divided into two series—a slow series of 6 to 24 inches per minute, and a fast series of 33 to 128 inches per minute. These changes in work speed and table feed are readily available through the medium of two rotating levers conveniently located on the front of the machine. A dial beside each lever indicates the speed or feed in operation.

The headstock work drive plate is driven from the main driving shaft at the rear of

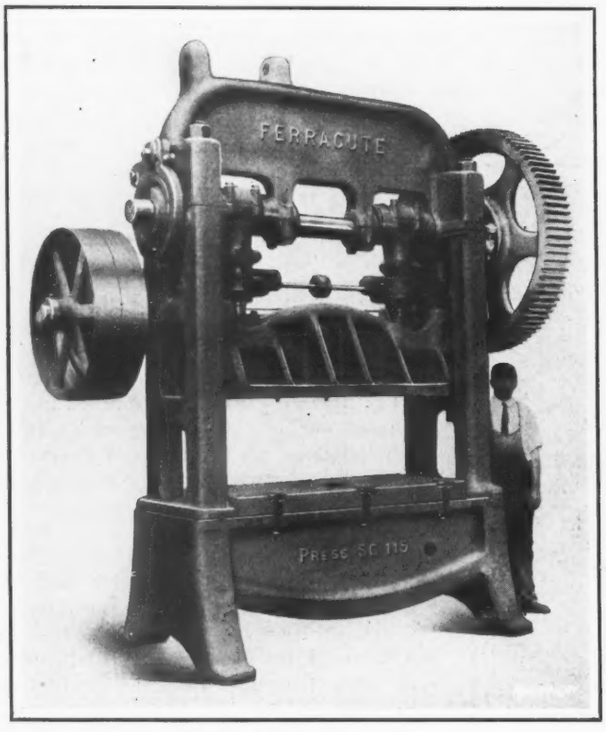
the machine, through the clutch and speed cases, to the transposing gears at the front. These transposing gears, which provide the fast and slow series of speeds, transmit the power to a splined shaft, upon which is mounted a splined sleeve contained within a bevel gear. This bevel gear meshes with another that is mounted on a shaft contained within the central pivot of the swivel table. Power is transmitted through the bevel gears to a shaft mounted within the swivel table and thence through two spur gears at the end of the table, one of which is mounted on the telescoping base-shaft of the headstock. The drive from this telescoping shaft is through a series of bevel gears to a short shaft within the headstock, from which the final drive to the work driving plate is by means of a silent

The equipment included with the machine is particularly complete, including an internal grinding fixture; an 8-inch four-jaw independent chuck; faceplate; face chuck; two universal back-rests; four adjustable bronze shoes; a center rest; two grinding wheels; one offset, 12 inches in diameter; one offset, 14 inches in diameter; a set of dogs; a set of telescopic water guards; and a full set of wrenches. Overhead works are also included, consisting of one pair of tight and loose pulleys, 18 inches in diameter for a 5-inch belt and a speed of 425 revolutions per minute. The machine weighs 6950 pounds and requires a floor space of 42⅝ inches, at right angles to the wheel-spindle, by 142 inches parallel to the spindle.

FERRACUTE SINGLE-ACTION PRESS

The accompanying illustration shows one size of a series of seven single-action geared presses designed and placed on the market by the Ferracute Machine Co., Bridgeton, N. J. The presses in this series all give the same pressure —100 tons—but differ in the distance between the columns, this difference affecting the dimensions of the bed, ram, and stay. The sizes of the clutch, gears, shaft, and pitmans are the same in all the presses of the series.

The present design differs from those previously built by the company in having the stay that unites the columns and the column heads all in one piece. There is also an improved form of ram adjustment and pitman. Four 3-inch steel rods, encased and shrunk in the cast-iron columns, take the tensile stress. The press may be run by belt from overhead shafting, or from a motor mounted on a motor shelf at the top of the press.

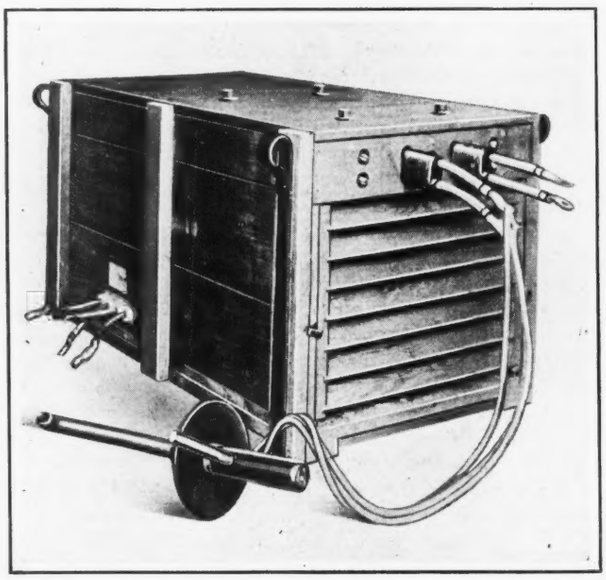


Ferracute Single-action Geared Press

The distance between the columns of the narrowest press of the series is 34 inches, and of the widest, 100 inches. On the press shown in the illustration this dimension is 70 inches. The weights vary from 16,700 pounds to 33,200 pounds, the size shown weighing 25,700 pounds. The stroke is 6 inches, and the distance from the bed to the ram, at the bottom of the stroke and the top of the ram adjustment, 19 inches. The latter dimensions may be changed to meet special requirements.

UNIVERSAL WELDING MACHINE

The accompanying illustration shows a new model universal welding machine brought out by the Electric Arc Cutting & Welding Co., 152 Jelliff Ave., Newark, N. J., for spot welding, lead burning, nickel spotting, and arc welding operations. This machine was previously made for operating on one or two voltages, but it can now be used in connection with any industrial power supply, either alternating or direct current of 60, 40, or 25 cycles. This change has been made without affecting the size of the machine. The combination of 110, 220, and 440 voltages is obtained by multiple, series multiple, and series combinations of the coils of the primary winding. To make the same machine operate on 25 and 40 cycles, taps and adapter windings are used. The apparatus is made operative on 110- and 220-volt direct current by means of a resistor-reactor combination inserted in the secondary winding.



Electric Arc Cutting & Welding Co.'s New Model Welding Machine

This machine is also made in a portable style, which is mounted on wheels and skids so that it may be easily moved about the shop by one man.

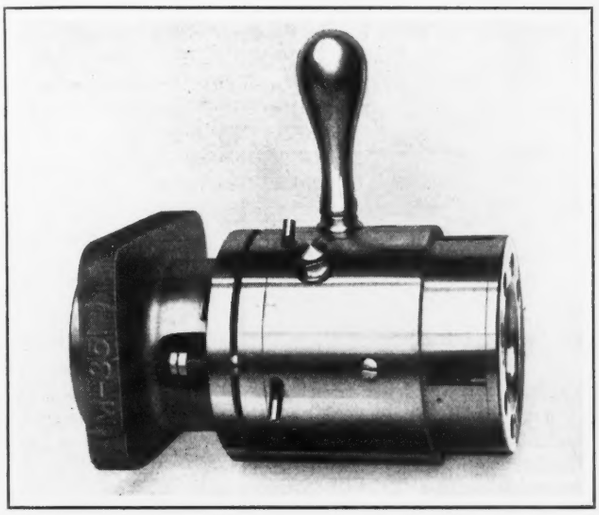
POLLARD FACTORY STOOLS

A complete line of factory stools has been added to the line of welded factory equipment manufactured by Pollard Bros., 4034 N. Tripp Ave., Chicago, Ill. These stools are all welded by the oxy-acetylene process, producing a very rigid stool that is practically non-breakable. The line consists of non-adjustable stools from 18 to 36 inches in height, and adjustable stools that have a height adjustment of 6 inches, in ranges from 18 to 36 inches high. Swivel stools are also made in both adjustable and non-adjustable types. The back-rests are adjustable for height, and are made of spring steel with a five-ply veneer wood back. All seats are

made of wood and in two sizes. To increase rigidity, all cross-braces are made from angle-irons and not from flat stock. The dome foot used prevents scratching the floor and slides easily. The wood parts are stained in a mahogany finish, and the steel parts are painted in black enamel.

H & G DIE-HEAD FOR TURRET LATHES

A modification of the style CC die-heads, especially for use on the Warner & Swasey 2-A and 3-A turret lathes, has been placed on the market by the Eastern Machine Screw Corporation, 23-43 Barclay St., New Haven, Conn. This new head, as shown in the accompanying illustration, is equipped with a special tool-holder to fit the hollow hexagon turret of these machines. The holder is so designed that it brings



H & G Die-head designed especially for Use on Warner & Swasey Turret Lathes

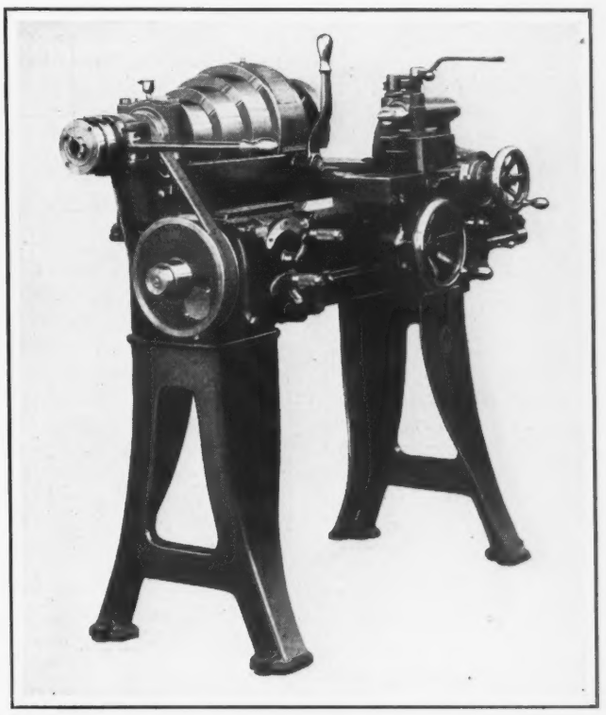
the die-head close to the turret with the minimum amount of overhang.

The adjustable "pull-off" of these heads is an important feature in that the operator does not have to advance the turret exactly in step with the lead of the thread cut. He simply follows approximately the feed of the head until approaching the point of tripping, when the advance of the turret is stopped. The head, continuing to advance, opens at the proper point. The advance of the turret may, therefore, be considerably behind the advance of the die-head without affecting the lead of the thread cut.

LEBLOND RAPID-PRODUCTION LATHE

The accompanying illustration shows a new 11-inch high-speed cone-driven rapid-production lathe, brought out by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. This machine is especially designed for the quantity production of small parts from the bar, of brass, bronze, aluminum, and similar metals or alloys requiring turning and facing operations at high cutting speeds. The design of the main units of the machine are identical with those of the LeBlond 11-inch heavy-duty production lathe illustrated and described in July, 1922, MACHINERY, page 921, and the same distinctive features are present—the drop brace, bucket type headstock, heavy-duty bed, one-piece box-section apron with positive-feed clutch, and geared feed mechanism. The feature that is entirely new in the design of the lathe shown in the illustration is the headstock construction.

The headstock is of the three-step cone, open belt type, without back-gears, and is adapted for spindle speeds up to 1250 revolutions per minute. The drop brace, bucket type construction of the headstock permits the use of a



LeBlond High-speed Cone-driven, Rapid-production Lathe

cone pulley of unusually large diameter. This construction also permits the use of an effective connecting web between the front and rear spindle housings, with consequent increase in rigidity. The spindle, a high-carbon crucible forging, is mounted in annular ball bearings, and is provided with adequate lubricating facilities. A large hole through the spindle permits of passing work through it or of mounting draw-in or expansion chucks, either hand or pneumatically operated.

Within the largest step of the cone, a powerful multiple disk friction clutch is mounted for starting and stopping the spindle. The clutch is operated by a conveniently located lever on the front of the headstock, which, upon releasing the clutch, automatically applies a micarta adjustable cone friction brake, which brings the spindle to an instant stop. The driving cone is carefully balanced to eliminate vibration even at the highest speeds.

MILBURN OXY-ACETYLENE MIXING TIP

A development in oxy-acetylene cutting apparatus has recently been introduced to the trade by the Alexander Milburn Co., 1416 W. Baltimore St., Baltimore, Md. This comprises what is known as a "Super" mixing tip for cutting, which, while embodying all the desirable features of the standard torch tip, has additional features of value for the work for which it is intended. The special advantages claimed for this tip are the methods of mixing the gases and pre-heating the oxygen, as well as the velocity and attendant penetration of the jets. The tip is provided with a renewable seat which can be replaced at a fraction of the cost of the complete tip, making it unnecessary to remachine or discard the used tip. This renewable seat also facilitates the cleaning and maintenance of the tip.

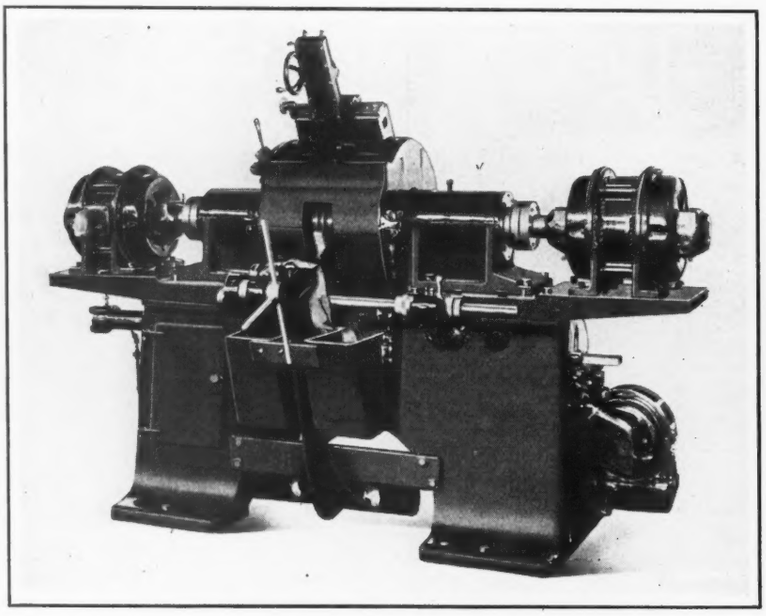
The mixture of the preheating gases takes place in multiple passages in the renewable seat. The gases then pass into an annular passage, where they are given a swirling motion and are further mixed. From here they pass through enlarged multiple passages leading to the orifices of the tip proper. At this point the preheating flame is projected toward the high-pressure oxygen jet in such a way that a speedier cut, a narrower kerf, and a material saving in gases is obtained. The following figures, obtained from cutting tests, are given by the maker to indicate the econ-

omies of the new tip over standard tips made by the company: Saving in time, 17.5 per cent; saving in oxygen, 10.9 per cent; saving in acetylene, 25 per cent; saving in cost of operation, approximately 18 per cent. The new tip is interchangeable with all sizes of Milburn cutting tips, and fits all the torches made by this company since 1916.

GARDNER DOUBLE-SPINDLE DISK GRINDER

A machine known as the Gardner No. 27 double-spindle disk grinder has been brought out by the Gardner Machine Co., 414 E. Gardner St., Beloit, Wis. This machine has been in operation for some time in several large factories in various parts of the country, and is now announced generally to the trade. The outstanding feature of the machine is the Oilgear hydraulic feed, which operates the sliding heads through a double-acting hydraulic cylinder mounted on the left-hand end of the base casting and directly connected to the sliding head at that end of the machine. Connection to the head at the opposite end is by means of a rack and pinion. Oil under pressure is supplied to the operating cylinder by an Oilgear pump mounted at the rear of the machine and driven either from a countershaft or from an individual motor.

The oil pump is entirely enclosed, self-contained, and the oil reservoir is built into the pump. Pipes run along the back of the machine to the cylinder, and the control shaft passes through the base to the front, where it may be operated either by a hand- or a foot-lever. By means of adjustable stops on the control lever, the speed at which the sliding heads travel may be adjusted as required, depending upon the area of the surface and the material being ground.



Gardner Double-spindle Disk Grinder with Hydraulic Feed

The grinding pressure available when the Oilgear hydraulic feed is used is very high, and it is therefore necessary to protect the mechanism against excessive pressure. For this purpose, two relief valves are embodied in the pump, one for the feed and one for the return motion. These valves are set in the shop of the builder of the machine to give the maximum grinding pressure suitable for ordinary wheels. This feature provides full protection for wheels and work.

The distance that the grinding heads travel is regulated by a positive stop having a micrometer adjustment. This stop is placed directly on the sliding heads, and its action is not dependent on any other mechanism; consequently, the accuracy in width to which work may be ground is within very close limits.

The grinding member consists of 20-inch steel disk wheel faces provided with what is known as the "Gardner Improved Abrasive" disks, or 18-inch diameter ring wheels. These grinding members are completely enclosed by a hood having an opening at the front just large enough to allow the work being ground to pass through. This hood acts not only as a guard for the grinding wheels, but also effectively confines the dust or spray of grinding and thus affords great protection to the moving parts of the machine. On the top of the hood is mounted a horizontal slide with screw adjustment carrying the wheel-truing device, consisting of a Ross dresser held in a gibbed vertical slide operated by a handwheel through a rack and pinion. The dresser is always in position ready for use, and yet does not interfere with the set-up or operation of the machine. It is unnecessary to stop the grinding wheels to bring it into action.

The spindles carrying the grinding wheels are of large diameter, mounted in S K F ball bearings of the deep-groove type, with a rated capacity greatly in excess of any load that the bearings are likely to be called upon to carry. The bearings are enclosed in dustproof housings, and all sliding surfaces are well protected from dust and grit.

The fixture in which the work is carried is mounted on a swinging arm, carefully counterbalanced, so that very little effort is required in operating it. This arm is hinged on a bracket bolted directly to the base of the machine. The hinge shaft is carried in bushings that are easily renewable when they become worn. By attaching the hinge shaft directly to the base of the machine, rigidity is obtained, and the shaft, being well under the base, is removed from grit and dirt. The long radius on which the fixture swings permits the work to travel along a nearly horizontal line when passing to and fro over the grinding wheel.

Work may be ground either wet or dry. The hood has an exhaust connection, and a water tank is built into the base casting for which pump and connections may be furnished. Fixtures can be provided for a variety of work, and the machine is built with a number of ranges of openings between the grinding wheels. It can be equipped for either belt or motor drive. The motor-driven type has a 7½-horsepower motor for each spindle, mounted on extensions of the sliding heads, and directly connected to the machine by noiseless flexible couplings.

As an example of work that has been performed on this machine may be mentioned the grinding of the ends of eyes of automobile leaf springs. The production obtainable on springs 2 inches in width, with eyes 1 5/16 inches in diameter, is about 400 eyes per hour. The area of surface ground per eye is approximately 1½ square inches, with an average stock removal of 1/16 inch. The tolerances within which the spring eyes are held are 0.002 inch for length, 0.001 inch for parallel ends, 0.002 inch for squareness with bushing hole, and 1/16 inch in 18 inches for parallelism with the leaf of the spring.

DRESES MULTI-DUTY RADIAL DRILLING MACHINE

A new 6-foot multi-duty ball-bearing radial drilling machine is being introduced to the trade by the Dreses Machine Tool Co., Cincinnati, Ohio. Among the features specifically mentioned are a fool-proof elevating mechanism, enclosed

gearing, simplified lubrication, easy operation, and unusual power. The head is entirely enclosed and mounted on three bearings on the arm, two in front and one in back. It can be clamped in any position on the arm by means of a lever at the lower right-hand corner, which is used to actuate two widely separated screws, that draw the head firmly up against the lower guide rail. This design assures proper alignment of the spindle. The traverse of the head is obtained by means of the handwheel at the lower right-hand corner which operates through a ball-bearing mechanism.

The head is lubricated by a splash and force-feed system. The forward and reverse gears and friction clutches run in a separate oil bath, while the back-gears and spindle-driving gears are oiled by a pump which takes filtered lubricant from a reservoir and pumps it through the glass sight on top of the head. The lubricant cascades over all gears and bearings and finally returns to the reservoir. The spindle and all feed and traverse mechanisms are oiled by means of a tilting hopper which distributes a predetermined amount of oil taken from the circulating pump supply. This hopper is manually operated by a lever on the outside of the head.

The thrust of the spindle is taken by two ball bearings, and the rack teeth are cut directly on the spindle sleeve. The rack pinion has a special form of tooth which eliminates the under-cut usually found below the pitch line of small-diameter pinions. The tapping, starting, and stopping mechanism, which is embodied in the head, is of the frictional type, and is operated by the horizontal lever seen below the arm. Four speed changes are obtained through the two levers at the lower left-hand corner of the head and these, combined with the eight changes obtained through the speed box, give thirty-two spindle speeds. The gear that drives the spindle rests on an annular ball bearing placed well inside the gear to eliminate objectionable overhang. There are fifteen feeds for the spindle, five of which give the proper lead for tapping 8, 11½, 14, 18, and 27 threads per inch, respectively. The feeds, shown on a prominent index-plate, are instantly available. A safety friction device is interposed in the drive in addition to the large quick-return friction clutch.

This quick-return friction clutch is easily adjusted from the outside by means of a screwdriver, and is operated by four different levers. There is an automatic trip and depth gage which functions positively even under the heaviest feed. The dial is graduated in even divisions to avoid complicated reading when the desired depth exceeds one revolution of the rack pinion. A positive safety trip is provided at each end of the spindle travel. Eleven annular and three thrust ball bearings are used in the head construction.

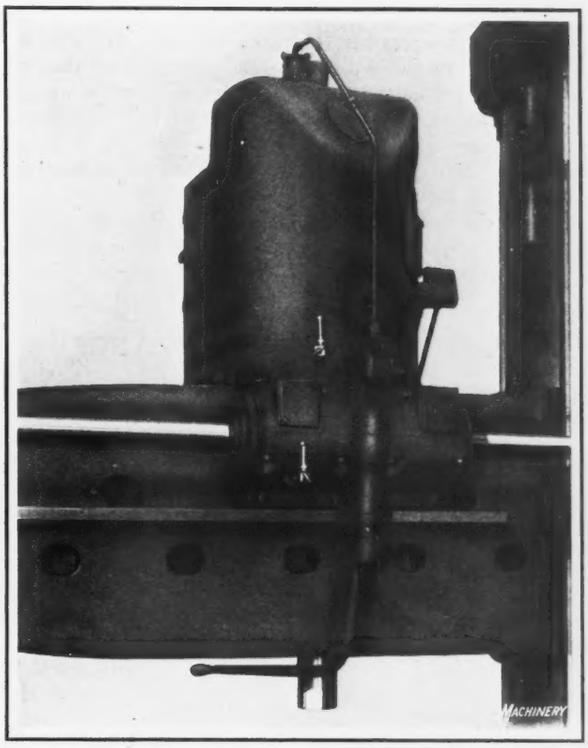


Fig. 2. View of the Head and Radial Arm from the Rear

The top cap on the column is entirely enclosed and lubricated by three glass oilers. The long hub of the gear which drives the vertical shaft in the column is fitted with a longitudinally yielding contact which eliminates improper meshing of the gears, prevents the heavy shaft from riding on the gear teeth and compensates for wear between the column and stump. The speed-box is of the cone and tumbler type operated by one lever. To overcome shock when changing speeds, the machine is always run at the slowest speed at that time by means of a self-releasing overtake clutch. This entire mechanism also runs in an oil bath.

The radial arm is of the box parabolic shape, and the lower rib is double to give ample resistance to bending and torsional strains. The arm is lowered at twice the elevating speed and an automatic trip is furnished at both extremes. The elevating and lowering mechanism is said to be absolutely fool-proof, a single movement of one lever unclamping, elevating, or lowering and then securely reclamping the arm. This is accomplished without the operator leaving the front of the machine, and the arrangement eliminates the danger of all such accidents as the engagement of the elevating mechanism while the arm is clamped. In addition to this, the gearing is automatically disengaged if any obstruction is met in elevating or lowering the arm. The column is composed of two parts, the inner member being bolted to the base and reaching to the top of the outer sleeve. The annular and thrust loads are taken on roller and ball bearings.

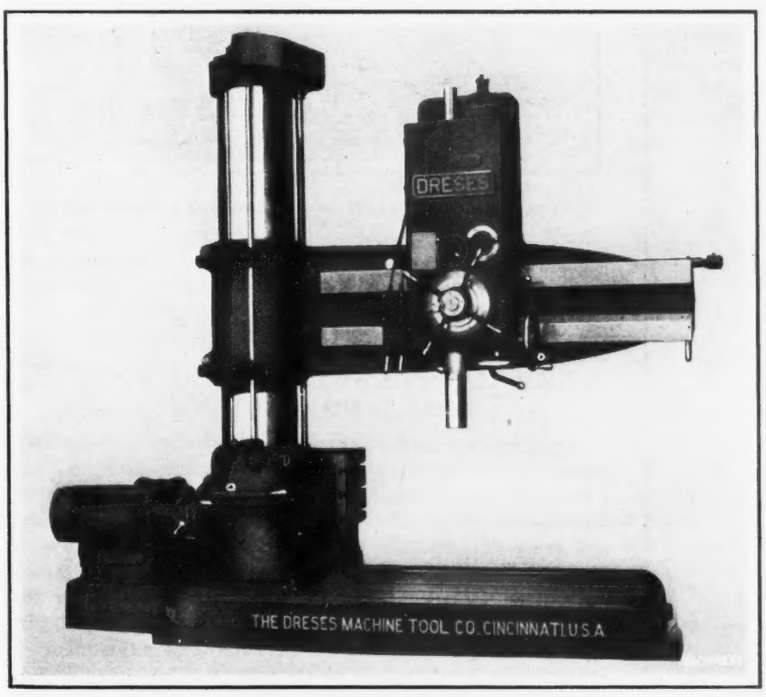


Fig. 1. Dreses Multi-duty Radial Drilling Machine

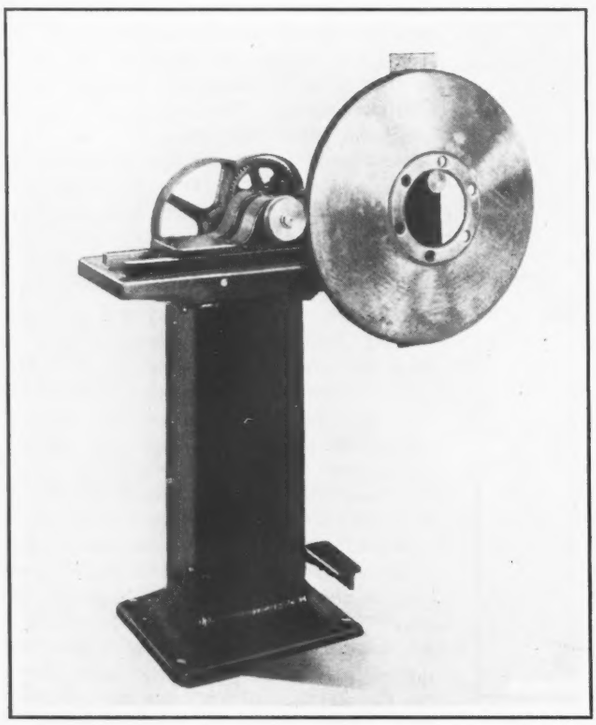
One of the features of the machine particularly pointed out is that all operating levers on the head are within a radius of 17 inches without being crowded and that the operating levers at the base of the column, including that of the speed-box, the column clamp, and the combination arm-clamp and elevating handle, are also within a 17-inch radius. A plain box table is regularly furnished with the machine, but a universal table may also be supplied. There are three standardized interchangeable drives—a belt drive through a speed variator, a constant-speed motor drive through a speed variator, and a variable-speed motor drive.

NOBLE & WESTBROOK FLANGE-MARKING MACHINE

A marking machine designed for the purpose of stamping the size, number, and trademark on the inner surface of the flange of disks that form the centers of disk wheels for automobiles, has been developed recently by the Noble & Westbrook Mfg. Co., Hartford, Conn. The stamp is in the form of a roll, 3 inches in diameter, having the permanent portion of the lettering in raised characters on its periphery. The numbers and sizes appear on separate segments that are fastened to the periphery of the stamp roll and are easily changed to suit the work.

The stamp roll on the machine shown in the illustration is hidden by the work. The roll that is exposed turns idly on its supporting stud and applies the pressure necessary to sink the characters of the stamp roll into the work. This pressure roll, with its stud, is mounted on a horizontally sliding head that is operated to and from the work by means of a treadle and toggle lever, so that the amount of movement and consequent pressure, is determined by the setting of the machine and not by the amount of weight applied to the treadle. The stamp roll is driven through back-gears having a 1 to 15 ratio, from the driving pulley in the rear of the machine. With a stamp roll 3 inches in diameter, a stamp 9 inches in length is available. The diameter of the stamp roll is, however, a factor of the work, and in this case could be increased to 6 inches if desirable, with a correspondingly increased length of stamp.

The stud on which the work is mounted is adjustable for various diameters, and by changing this stud, other disks or pieces similar to disk wheels can be marked on this machine. The rate of output is limited only by the ability of an operator to handle the work, as the marking operation takes only one or two seconds. The machine occupies a floor space of 3 by 4 feet, and weighs approximately 500 pounds.

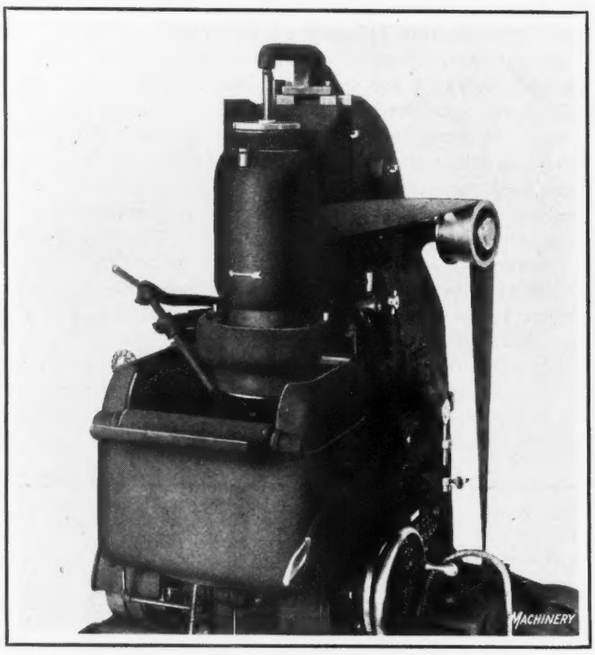


Noble & Westbrook Marking Machine designed for stamping Numbers on the Flanges of Automobile Disk Wheels

WHEEL GUARD FOR WALKER GRINDER

The accompanying illustration shows a new wheel guard and water-pan that has been provided for the single-stroke surface grinding machine recently placed on the market by the O. S. Walker Co., Inc., Worcester, Mass., which was described in detail in December, 1923, MACHINERY, page 309. The present design of wheel guard and water-pan differs from that previously shown in that the drop guard is hinged and falls straight out from the pan, whereas in the original design, the drop guard was semicircular in shape and hinged at the two ends of the semicircular construction, inside the circular water-pan.

The present water-pan is rectangular in shape. In the original design there was a somewhat limited access to the magnetic chuck for inserting or removing work. The present design gives access for the full width of the opening when the drop guard is lowered. This increases the utility of the machine in handling large work. All other details remain the same as referred to in the illustrated description previously mentioned.



Walker Surface Grinding Machine equipped with a New Design of Water Guard

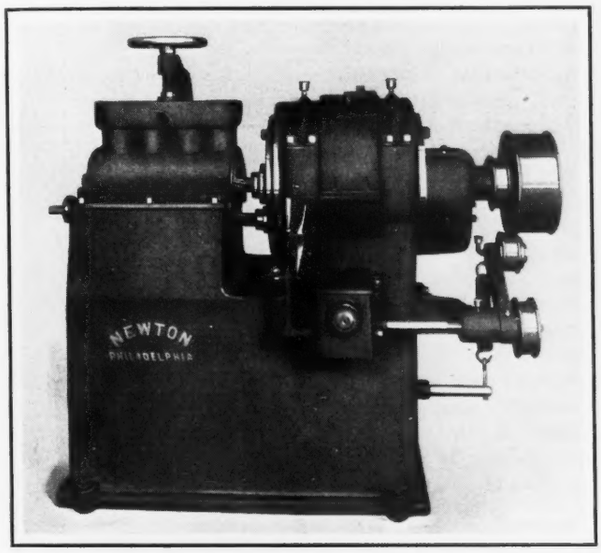
NEWTON PLANETARY TYPE RADIUS MILLING MACHINE

A machine for milling the ends of automobile crankcases, known as a planetary type radius milling machine, has recently been developed by the Newton Works of the Consolidated Machine Tool Corporation of America, Wilmington, Del. This machine is equipped with two spindles—one for the roughing and one for the finishing cutter—which are driven by spur gears meshing with a pinion on the main driving shaft. Both spindles are adjustable radially, and the roughing spindle has a horizontal adjustment to compensate for wear of the cutters. The spindles are mounted in a drum, which is driven by a worm and worm-wheel, and which rotates at the rate of 0.58 revolution per minute, which, on a 9½-inch diameter milling circle, gives

a feed of 17.4 inches per minute. The drum is fitted with a hardened steel dog which automatically trips the feed after the cutters have completed one cycle; and when the jig has been reloaded, the feed is engaged by hand by means of the lever shown in front of the machine in the illustration. The driving gears are of steel and bronze, except the worm-wheel on the drum, which is made of cast iron. They are all fully enclosed and run in oil.

The fixture for holding the work is fitted with taper gibs, and is adjustable horizontally by means of a screw fitted with a micrometer dial. The work is located by a bar fitting into the crankshaft bearings, and rests on hardened steel plates and locating pins. It is clamped by means of a screw clamp and a large handwheel.

As an illustration of the production that is possible on this machine, the crankcases shown in the illustration,



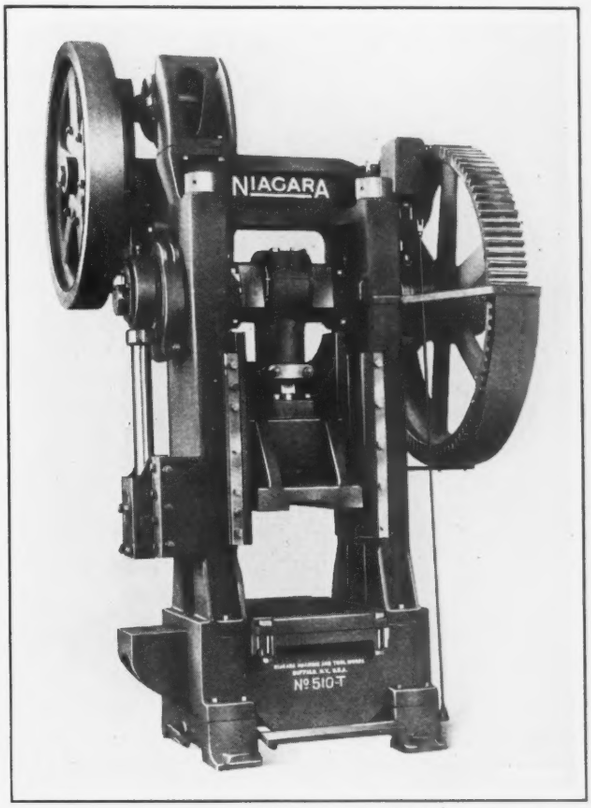
Newton Milling Machine designed for milling the Ends of Automobile Crankcases

which, in this instance, are cast integral with the cylinders, are machined at the rate of 250 in an eight-hour day.

NIAGARA TRIMMING PRESS

A recent addition to the line of power presses made by the Niagara Machine & Tool Works, Buffalo, N. Y., is shown in the accompanying illustration. This is a new type of trimming press known to the trade as the No. 510-T. It will be seen that this machine is of the single-crank straight-sided construction, provided with an outer slide for trimming work. The outstanding feature of this press is the tie-rod construction of the frame, which is similar to that employed in large double crank presses. The frame is made in four pieces consisting of the bed, two uprights, and the crown, which are bolted together and tied by four steel rods shrunk into place.

This press is particularly suitable for forge shop use, a class of service in which machines are often subjected to considerable abuse. The rods are of sufficient capacity to carry the full load of the press, and consequently the uprights are not subjected to tensile stress; thus the possibility of breaking the frame through overstrain or accident is obviated. The drive is located overhead out of the way of the operator and where the bearings are not exposed to scale and dirt which are so prevalent in this class of work. The action is controlled by the Niagara jaw clutch which is especially designed to suit forge shop conditions. A dovetailed recess is provided in the bottom of the slide for use in mounting the dies. Flanges extending toward the front and back on the bottom of the slide increase the bearing surface for the dies.



Niagara Press equipped with Outer Slide for Trimming Work

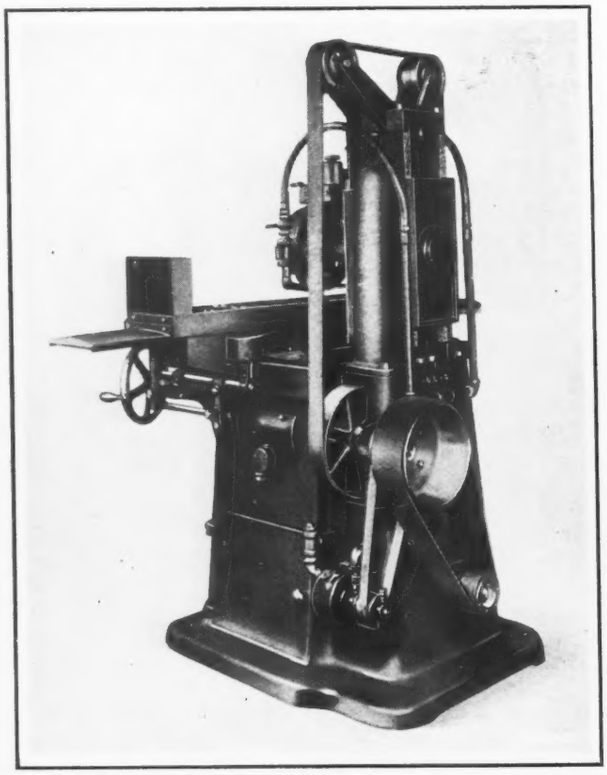
The outer slide of the press is actuated by an eccentric, keyed to the main shaft, and can be used for holding either cutting tools or punching dies. There is a round hole in the bottom of the slide in which the cutter holders or punch shanks can be fastened by means of a set-screw. The vertical position of the outer slide can be adjusted by turning the connecting-rod, which is threaded at its lower end into the pivot block of the slide. The bed for the outer slide is cast integral with the frame, and a round hole is provided in it to accommodate dies for punching operations. The press is shown in the illustration arranged for individual geared motor drive, the motor being supported by a bracket attached to the crown.

The area of the bed is 40 by 27 inches, and the die space from the bed to the slide, with the stroke down and the adjustment up, is 16 inches. The standard stroke of the slide is 6 inches, and adjustment, 4 inches. The stroke of the outer slide is 3 inches. The shipping weight of the press is approximately 27,000 pounds.

WILMARTH & MORMAN MOTOR-DRIVEN SURFACE GRINDER

The No. 78 automatic surface grinder built by the Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich., is now arranged to be driven directly from a motor installed within the base of the machine. Placing the motor inside the base completely protects it from grit, dust, and water. Furthermore, this arrangement reduces the amount of floor space required for the grinder, and from the standpoint of safety is much more desirable, as all exposed belts can be easily guarded. Friction has been reduced to a minimum by the use of ball bearings, so that a two-horsepower motor is adequate for driving this surface grinder.

A feature recently added to the machine is the control of the longitudinal table travel. Heretofore, when changing from hand to automatic feed, it was necessary to disengage a pin located at the center of the handwheel, in addition to operating the hand-lever that engaged or disengaged



Wilmarth & Morman Surface Grinder arranged for Motor Drive

either feed. In the new design, this pin has been eliminated entirely, and only one simple movement of the hand-lever is now required to change from hand to automatic feed. The control wheel in front of the table remains absolutely stationary, and does not swing to and fro as is usually the case. When it is desired to use the hand feed, the hand lever is merely moved in the opposite direction and the table is engaged, ready for hand feed, the same movement automatically disengaging the power feed.

Another interesting feature of the machine is the clutch, which is of a ball-bearing type fully covered by patents. With this new clutch there is no vibration and shock when the table reverses at each end of the stroke. The weight of the machine, completely arranged for motor drive, is 2200 pounds.

CRESCENT THREE-WHEEL TRACTOR

The three-wheel tractor shown in the accompanying illustration has recently been brought out by the Crescent Truck Co., Lebanon, Pa. This tractor is of a much heavier type than those previously built by the company, and is intended for especially hard service. It is equipped with a special General Electric motor having ample overload capacity; a Cutler-Hammer controller is used. The drive is by means of a worm and worm-wheel and a Brown-Lipe differential. The frame is built up of structural shapes, hot-riveted, and all castings are steel. The driving axle shaft is made from heat-treated chrome-nickel steel. Timken roller bearings and S K F ball bearings are used in the driving unit.

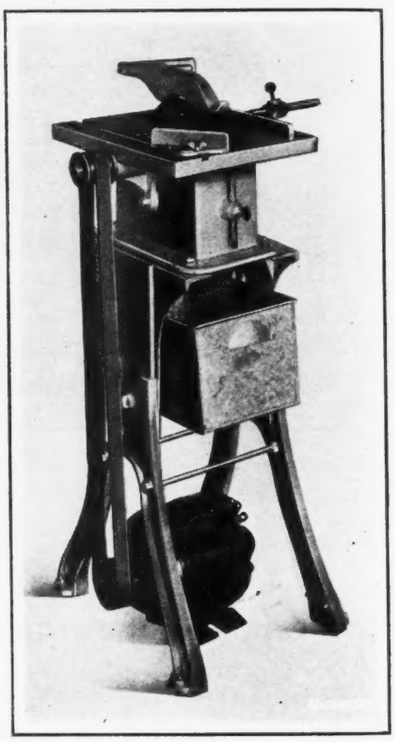


Crescent Three-wheel Tractor

UNIVERSAL CUTTING MACHINE

Steel, iron, soft metals, wood, and composition can be cut on the M. V. No. 5 universal saw made by the Commercial Electrical Supply Co., Broadway and Spruce Sts., St. Louis, Mo. Different sizes and styles of saw blades and cutters are supplied to suit the work to be handled. The table is hinged so that the saws and cutters can be quickly and conveniently changed.

The machine is made in both belt-driven and motor-driven styles. In the latter type, the motor is located underneath the machine, as shown in the illustration, thus requiring no additional floor space, and the cutter-arbor is driven direct by belt from the motor. The motor furnished in connection with the machine is of one-half horsepower, 110 or 220 volts, alternating- or direct-current. It operates at a speed of 1750 revolutions a minute, driving the saw at 3600 to 4000 revolutions per minute.



Machine for cutting Steel, Iron, Soft Metals, Wood or Composition

The dimensions of the belt-driven machine are as follows: Table size, 10½ by 13½ inches; base, 7½ by 12 inches; height, 10 inches; and weight, 43 pounds. The dimensions of the motor-driven machine are: Table size, 10½ by 13½ inches; base, 16¼ by 18¾ inches; table height, adjustable to from 33 to 36 inches; and weight, complete with motor, 118 pounds. The light weight of the machine puts it in the portable class, enabling it to be easily taken to the work if desired.

FOX AUTOMATIC DRILLING AND TAPPING EQUIPMENT

Several machines of the multiple-spindle type have recently been built by the Fox Machine Co., Jackson, Mich., for drilling and tapping on a high-production basis. Each of these machines is equipped with a patented cluster plate that permits of locating the desired number of spindles within a comparatively small space. These machines are designated as "No. 22-C." The one illustrated in Fig. 1 is operated automatically and drills an average of 2160 magneto pole pieces per hour. The work is placed on the sides of the hexagonal table drum, which is indexed to bring the

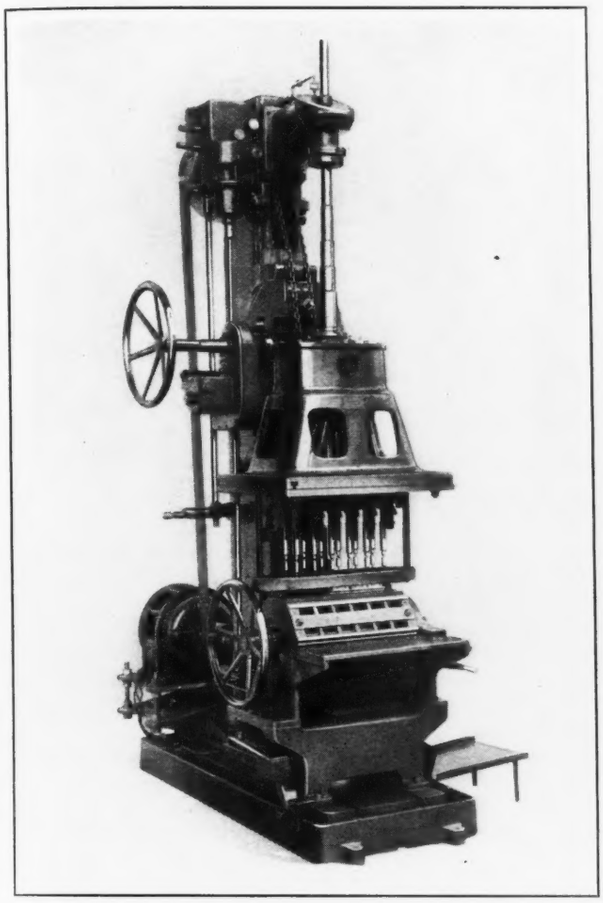


Fig. 1. Fox Automatic Multiple-spindle Drilling Machine

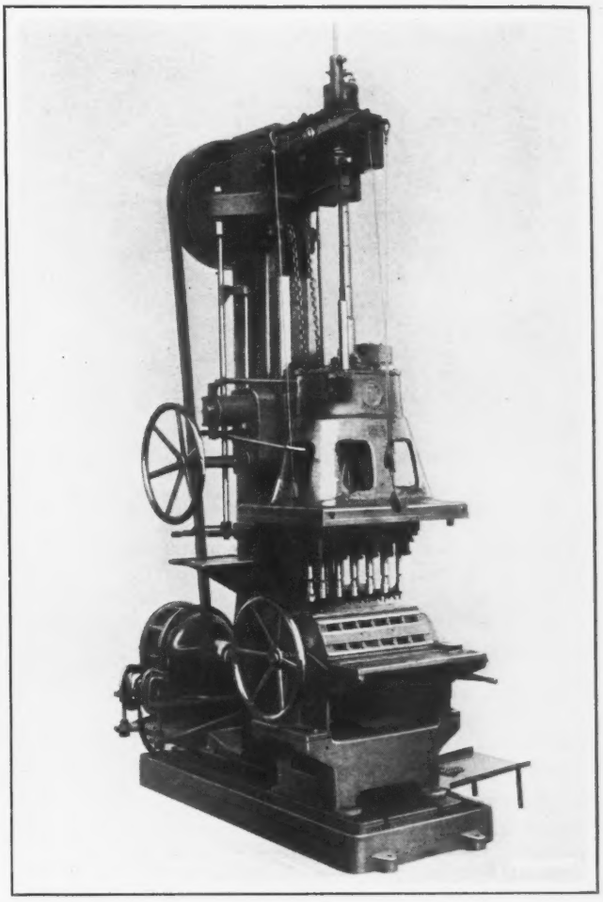


Fig. 2. Machine for tapping the Pieces drilled on Machine in Fig. 1

work under the spindles and to carry it away when completed. The spindle head is fed downward automatically by a cam, and returned through spring pressure and gravity weights. As the head is raised after each operation, the drum is indexed by hand for the succeeding operation. Six finger plates hold twelve pieces of work on each side, the work being discharged automatically as the various sides rotate to the bottom.

Six rotating speeds are provided for the cam, and there are three drill-spindle speeds—517, 773, and 1061 revolutions per minute, respectively. The travel of the head is 1½ inches. The twelve spindles are mounted in short arms doweled to the cluster plate, which is bored to accommodate sixteen spindles. Force-feed lubrication is furnished throughout. The weight of this machine is about 6528 pounds.

In Fig. 2 is shown a machine built for automatically tapping the pole pieces drilled in the machine just described. The head of this machine also carries twelve spindles mounted on a cluster plate, the spindles being provided with floating holders for the taps. Twelve parts are tapped at one time the same as in the drilling step. As the table drum is rotated to the working position, the operator either pulls the right-hand cord or depresses the pedal at the lower right-hand side of the machine to start the taps revolving in the right-hand direction and start the downward feed of the head at the proper rate to suit the lead of the taps used. The production with this machine is the same as with the drilling unit, and it weighs about 7072 pounds.

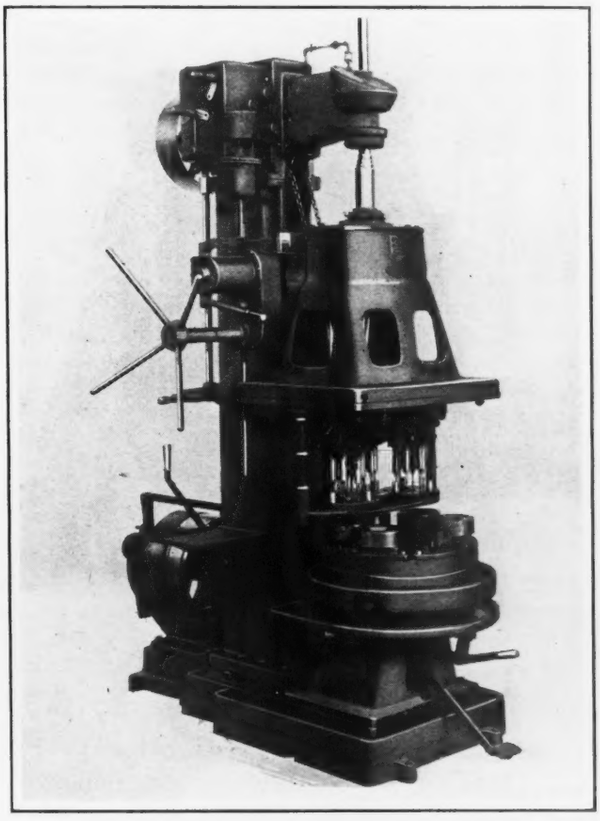


Fig. 3. Machine for simultaneously drilling Three Brake-drums

Fig. 3 illustrates a machine built for drilling three brake-drums at one time. This machine is equipped with a 22-inch table which has two indexed positions. The head is bored to accommodate twenty-four spindles, but only eighteen are used, these being arranged in three clusters as shown in Fig. 4. A jig plate for guiding the drills is carried with the head. The weight of this machine is about 2900 pounds. In Fig. 5 is shown a cluster plate with thirty-three spindles; this illustrates the method of holding the spin-

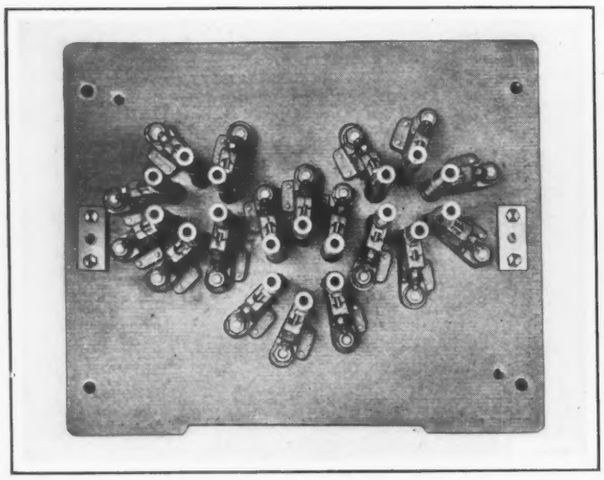


Fig. 4. Plan View of Cluster Plate furnished on the Machine illustrated in Fig. 3



Fig. 5. Thirty-three Spindles mounted on a Cluster Plate for drilling Automobile Cylinder Blocks

dles in the desired positions on the cluster plate and gives an idea of the large number of holes that can be drilled over a small area. These spindles are set for drilling the bolt and water-circulation holes in the top of an automobile engine cylinder block.

BETTS DOUBLE-DRIVEN BORING MILL

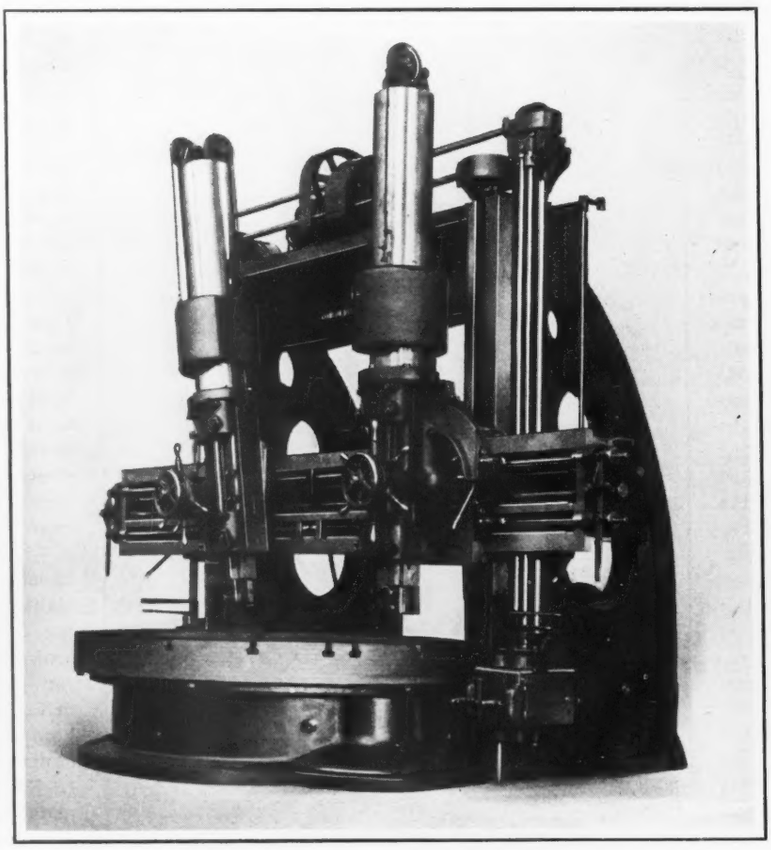
An improved 100-inch vertical boring mill has recently been developed by the Betts Machine Works of the Consolidated Machine Tool Corporation of America, Wilmington, Del. The particular feature of this machine is a powerful table drive obtained by means of two spur pinions meshing with an internal gear of wide face and coarse pitch. These double pinions are so keyed to their shafts that they mesh evenly with the table gear, and are located on opposite sides of the gear to produce a smooth drive. The drive particularly adapts the machine to the work of railroad and other shops where it is desired to take heavy cuts at coarse feeds in steel castings. The table is of extra thickness, and is mounted on a long spindle provided with taper bushings at both the top and bottom bearings. These bushings are adjustable for wear and have means for automatically lubricating the bearings.

There are eight feeds for the saddles and tool-spindles, and these are controlled independently from each side of the machine. The feed changes are obtained through sliding gears and can be made while the machine is running. The power rapid traverse mechanism for the saddles and tool-spindles is driven by the motor on top of the machine, which is also used for raising and lowering the cross-rail. The feed and power rapid traverse are interlocked by a cam arrangement which disengages one before the other can be engaged. The power rapid traverse and feeds may be engaged, disengaged, or reversed, directly from the saddles by means of a patented arrangement of levers on the operator's side of each saddle.

Duplicate stationary levers are provided on each side of the mill for use when the cross-rail is in a high position, and there is an interlocking lever at each end of the cross-rail for selecting a horizontal or vertical movement. The feeds and power rapid traverse are reversed by means of friction clutches. Patented miter gears, graduated in thousandths of an inch, are located on each saddle for the convenience of the operator in making final hand adjustments of tools, horizontally or vertically.

The tool-spindles are counterbalanced by ring-type counterweights, the design of which provides counterbalance at all angles and eliminates chains and sheaves. The tool-spindles may also be raised or lowered by hand in addition to the power rapid traverse. The cross-rail is clamped to flanges at both the inside and outside of the uprights.

The driving motor is direct-connected through gearing to the speed-box. On machines driven by alternating current, there is a speed-box which provides twelve table speeds in geometrical progression and a friction clutch and brake for instantly starting and stopping the machine independently of the motor from either side of the mill. On machines driven by direct current, there



Betts Improved Double-driven Vertical Boring Mill

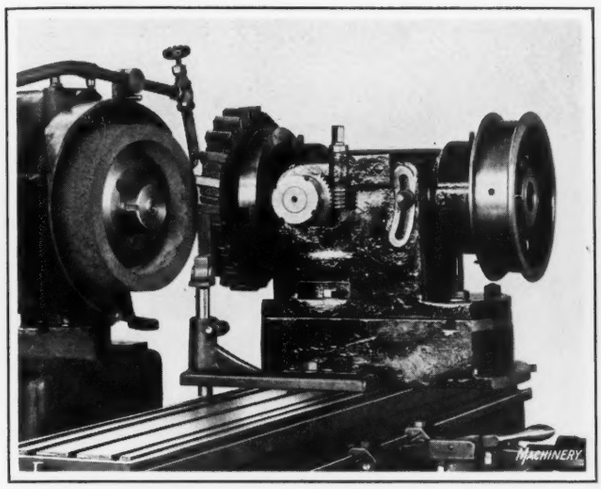


Fig. 1. Special Cutter-grinding Headstock developed for Use on the Thompson Universal Grinding Machine

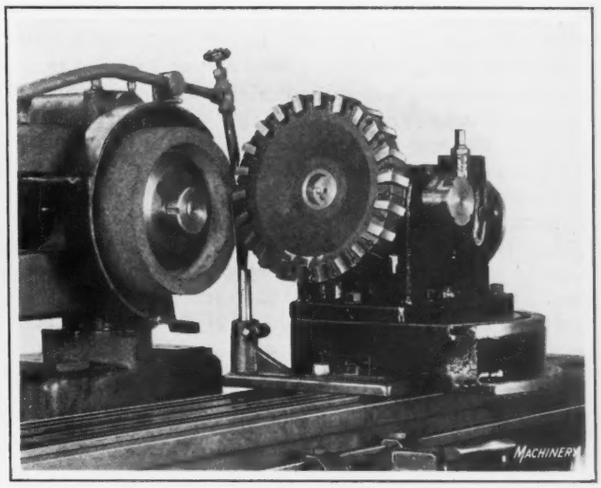


Fig. 2. Grinding the Periphery of the Cutter with the Spindle at Right Angles to Position shown in Fig. 1

are three mechanical speed changes which, in conjunction with the 3 to 1 adjustable-speed motor recommended, gives a total speed range of 27 to 1. A rheostat and dynamic brake in the motor controller, together with a push-button control, provide means of instantly stopping the machine or changing the speed.

THOMPSON CUTTER-GRINDING HEADSTOCK

To facilitate grinding large milling cutters, the Thompson Grinder Co., Springfield, Ohio, has developed a special headstock with a rated swing of 22 inches, for its universal grinding machines. In Fig. 1 this headstock is shown mounted on the right-hand end of the regular table of the machine, for use in grinding the faces of the inserted teeth of a large milling cutter, while Fig. 2 shows the headstock being used for grinding the periphery of the teeth. Fig. 3 illustrates the attachment in position on the left-hand end of the table.

The headstock spindle is mounted in roller bearings in a housing that is trunnioned near the front end of the frame, which, in turn, is attached to the base casting. The spindle housing may be swiveled vertically in the frame through an arc of 30 degrees by revolving the worm-shaft seen in Fig. 1 on the side of the frame. The spindle is held in the desired position by tightening clamping bolts on both sides of the frame. The base is in the form of a quadrant of a circle, and is provided with a T-slot on the top to permit swiveling the frame up to 90 degrees and clamping it in any position. The vertical and horizontal adjustments of the attachment allow the work to be set in any position for grinding at any desired angle of clearance.

Because of the possibility of mounting the attachment at either end of the grinding table, both right- or left-hand cutters may be ground, and the universal swiveling feature enables cutters to be sharpened on the face and periphery without removing the work from the attachment. A cup-wheel is used to obtain a straight angle clearance. The faceplate is integral with the spindle and can be made to meet any special requirements. For instance, the cutter shown in the illustrations is used on a Becker milling machine, and to facilitate the regrinding, the spindle flange of the headstock has been made identical with that on the milling machine. Thus the cutter may be bolted directly to the flange in the same position in which it is held on the spindle of the milling machine.

The spindle is 5 inches in diameter, is pack-hardened, ground, and provided with a No. 16 B & S taper hole. However, any size or type of hole may be supplied to suit requirements, and collets can be used to receive small-sized cutter shanks. The pulley at the rear end of the spindle can be belted to the drum shaft of the machine for cylindrical grinding operations. The cutter-rest shown in use in Fig. 1 contains a spring that causes the blade to snap under the successive inserted teeth of the cutter as the latter is revolved. With the cutter-rest shown in the other illustrations, the spring action is in the blade itself.

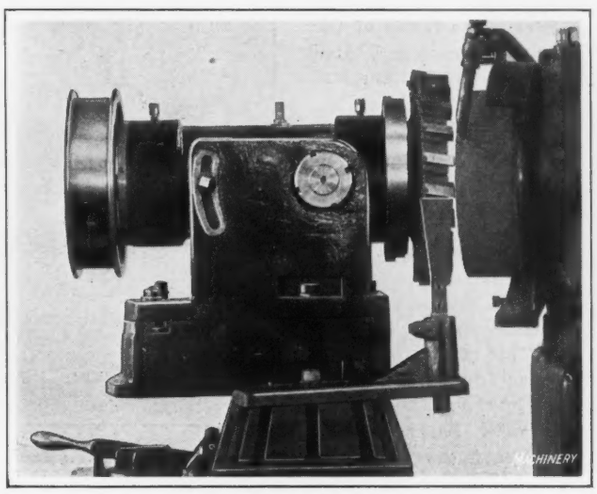


Fig. 3. Set-up of the Headstock at the Left-hand End of the Table

PRATT & WHITNEY HAND MILLING MACHINE

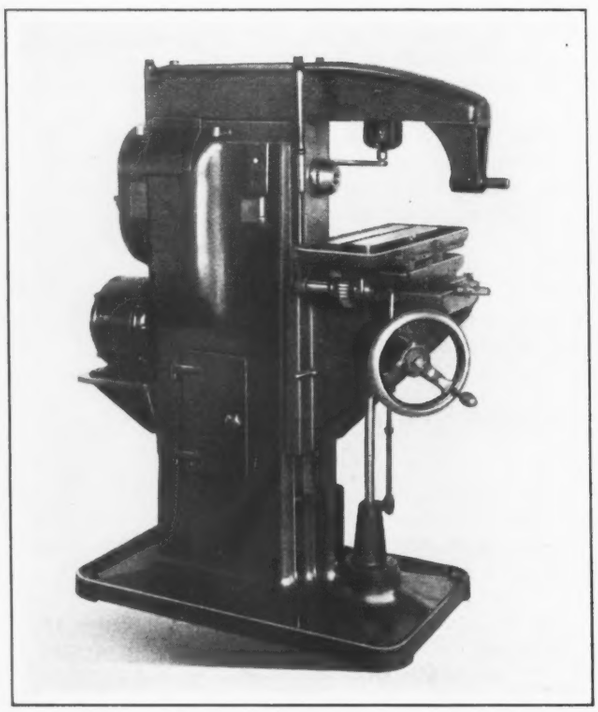
A 5-inch hand milling machine equipped with an individual motor drive, has recently been placed on the market by the Pratt & Whitney Co., Hartford, Conn. This machine is intended primarily for production work, but it is also suitable for general hand milling operations. The power may be controlled by either a push-button or a snap switch mounted on the machine itself. The motor is geared directly to the spindle so as to transmit the full power to the cutter, notwithstanding variations in the speed of the spindle. The column houses all gearing and moving parts. Transposing slip gears are used for changing the spindle speeds, and these are readily accessible through a cover on the rear of the column.

The motor is mounted on a bracket about half way up the column, this position being low enough to avoid any tendency toward vibration, and at the same time high enough above the floor to be kept clear of chips, sweepings, etc. Placing the motor on a bracket also makes it easily accessible for lubrication, inspection, and adjustment, and enables it to be quickly replaced. The machine may also be built with a single-pulley belt drive, a simple change making it possible to mount the pulley

within the column and do away with the gears that deliver the power from the motor on the motor-driven machine.

The overhanging arm is a ribbed casting designed to give a strong and rigid support. The outboard support is also a ribbed casting, which fits a T-slot on the under side of the arm. The arm is fastened to the column by four bolts, which are so placed that the arm may be reversed and fastened entirely out of the way to accommodate high work. A column cover is provided when the arm is not desired.

The table and feeding devices are similar in design to those of former hand milling machines built by this company. Stop-dogs are provided for both longitudinal and transverse movements of the table, and also for the vertical movement. The longitudinal travel is obtained through a lever, rack, and pinion, and the vertical travel by means of the large handwheel which engages the vertical elevating screw through miter gears. The cross-slide is operated by means of a crank, and is fitted with a micrometer dial to facilitate fine adjustments. The working surface of the table is 5 by 17 inches; the total longitudinal travel, 12 inches; the vertical travel of the knee, 8 inches; and the maximum distance from the top of the table to the center of the spindle, 9 inches. The range of spindle speeds is



Pratt & Whitney Motor-driven Production Hand Milling Machine

from 65 to 650 revolutions per minute. The machine may be equipped with a pump, in which case the inside of the column forms the oil reservoir, and the pump is located directly above the oil level and driven by a chain and sprockets from the main driving shaft.

YOUNG GRINDER

The special feature of the new grinder placed on the market by the Keuka Industries, Inc., Hammondsport, N. Y., is the construction of the spindle. From the sectional photograph reproduced in Fig. 2, it will be seen that at each end of the bearings the spindle extends across an oil well from which oil is picked up continuously. This results in a continuous film of oil sealing the bearings from grit or dirt. Any fine abrasive particles are caught by the oil and deposited as sediment in the bottom of the well. Because of the protection from dirt afforded by the oil, a groove is run

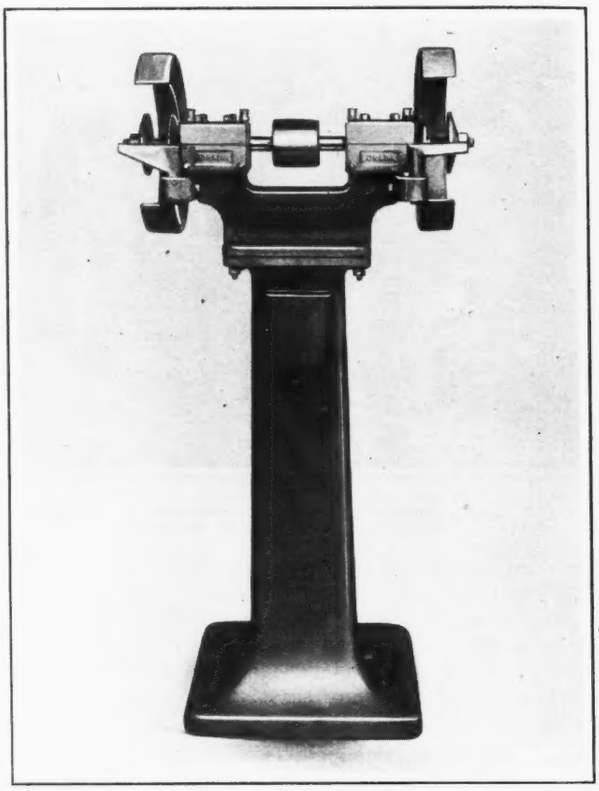


Fig. 1. Young Shop Grinder built by Keuka Industries, Inc.

right across the bottom of each bearing to connect the oil wells, and from these the groove is kept filled to insure constant lubrication of the spindle.

It will be seen that there is a series of V-grooves cut in the bearing portions of the spindle and into these grooves are seated the vees of the corresponding bearing box. This design automatically compensates for wear within reasonable limits, and results in the machine running smoothly, without chatter. The spindle is also made large in diameter to eliminate whip and to give a large bearing area. Its length is such that two men can conveniently work on the machine at one time. The tool-rests are so designed that they cannot turn while being used, but they may readily be pushed out of the way when not in use without removing them. When it is desired to drive from a countershaft, a self-oiling, loose pulley is also provided in addition to the equipment illustrated. The machine is built in two sizes which are equipped with 10- by 1½-inch and 12- by 2-inch wheels, respectively.

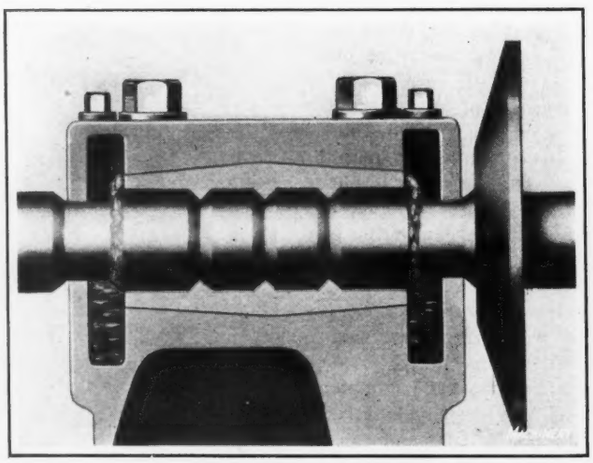
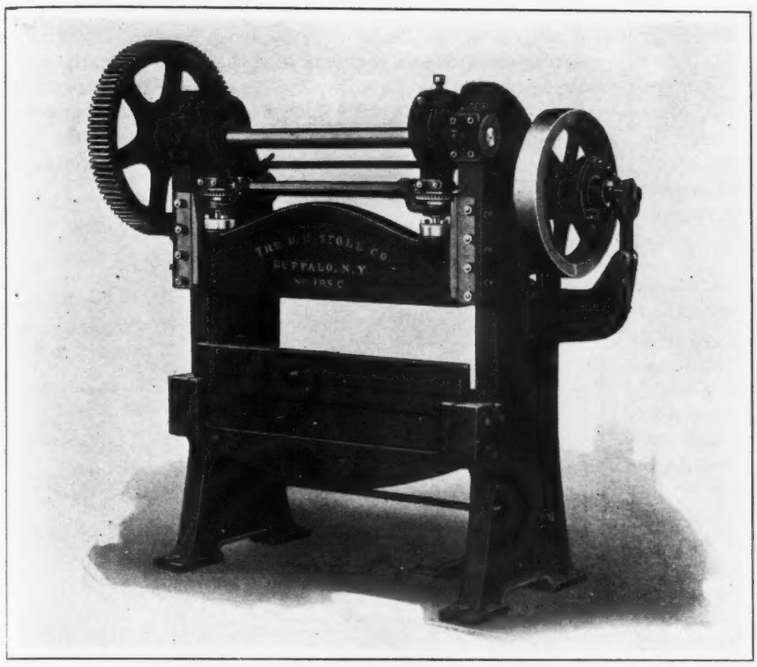


Fig. 2. Sectional View, illustrating the Construction of the Spindle



Stoll Light Power Brake for Operations on Sheet-metal Furniture, Filing Cases, etc.

STOLL POWER BRAKE

For operations on sheet-metal furniture, filing cases, shelving, partitions, medicine cabinets, and similar work, the D. H. Stoll Co., Inc., Military Road and Grote St., Buffalo, N. Y., has recently placed on the market a light power brake. This machine is especially intended for operations in which heavy power brakes are cumbersome. It is equipped with a foot-treadle-operated combined friction clutch and brake, which permits the operator to stop the machine at any desired position. This feature is particularly valuable in setting dies. The brake is also arranged with a special type of bed and slide that provide maximum clearances for bending work. A riser is furnished to permit the use of dies having extremely acute angles, and throughout the machine is designed to meet the varied conditions common in this class of work.

The maximum capacity of the machine is for No. 20 gage sheets, and other specifications are as follows: Distance between uprights, 51¾ inches; distance from center of slide to frame, 2½ inches; distance from bed to slide, with the stroke down and the adjustment up, 9½ inches; standard stroke of slide, 3 inches; height of riser, 4½ inches; overall height, 84 inches; floor space, 34 by 83 inches; and weight, about 3800 pounds.

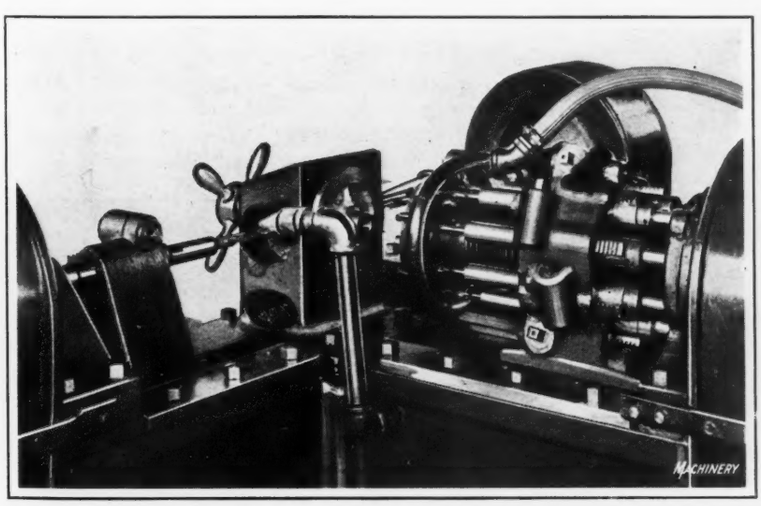


Fig. 2. View showing how the Spindles are arranged for drilling a Differential Case

STAMETS THREE-WAY DRILLING MACHINE

For simultaneously drilling the three flanges of valve bodies or three sides of other work, William K. Stamets, Jenkins Arcade Bldg., Pittsburg, Pa., has recently built a three-way horizontal drilling machine. In Fig. 1 the machine is shown being used for a valve job, while Fig. 2 shows the jig and set-up used in drilling the cross-pin and rivet holes in a differential case. The movements of the drill carriages are obtained by means of drum cams which provide a quick forward travel, a slow feed, and a quick return. Various feeds are obtained through change-gears which are readily accessible, the main feed gears being enclosed and running in oil.

Quick adjustment of the drill spindles to compensate for drills of different lengths is obtained through racks on the spindle sleeves and pinions meshing with these racks. A clutch in the feed mechanism is automatically tripped at the end of the drilling cycle, and it may be operated manually at any time. A friction safety device is also incorporated in the feed mechanism

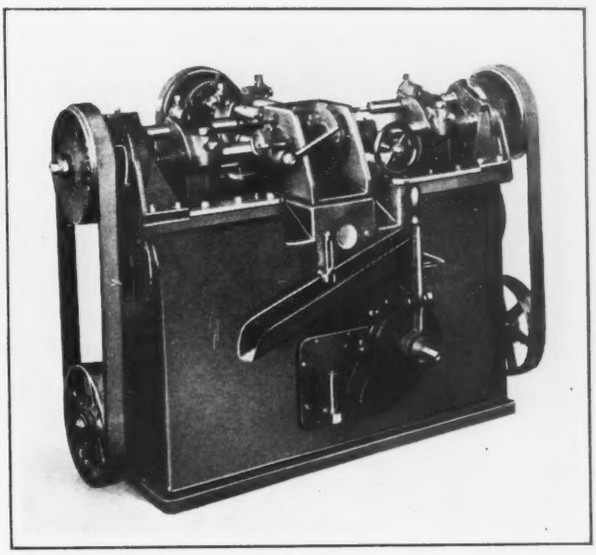
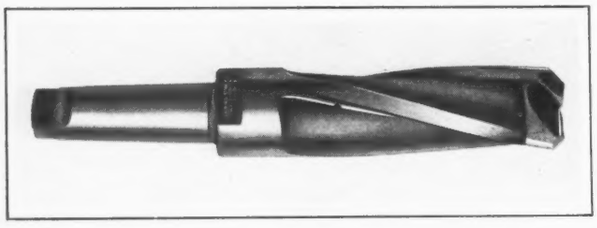


Fig. 1. Stamets Three-way Horizontal Drilling Machine

to prevent damage due to dull or broken points of drills or obstructions. Provision is also made for operating the feed mechanism by hand. On the jobs illustrated, the drilling of each piece is accomplished in about forty seconds floor-to-floor time. There are ten holes in each piece varying in diameter from 5/16 to 5/8 inch and in length from 1/2 to 1 inch. Particular attention is called to the small amount of floor space required for the machine, which is approximately 5 by 4 feet. The machine is motor-driven and weighs about 3500 pounds.

GAIRING CORE DRILL

Core drills of the type illustrated are made in a large range of diameters and with either three or five flutes by the Gairing Tool Co., Inc., Detroit, Mich., for rough-boring



Gairing Core Drill

forgings, castings, etc. It will be seen that it consists of a holder and a short cutter which is held in place by means of a pilot that can be quickly removed. The method of attaching the cutter to the holder and the manner of driving it are practically the same as with the cutters and holders illustrated in March MACHINERY. The holder is made of nickel steel, and as the tool is used through a guide bushing, the holder is hardened to reduce wear. Ordinarily the holder is made with a standard Morse taper and without the driving flats seen near the shank. Core drills of various special designs are also made, such as with a special pilot, cutter, or holder.

WILMARTH & MORMAN MOTOR-DRIVEN CUTTER AND TOOL GRINDER

The No. 1 universal cutter and tool grinder built by the Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich., is now arranged to be driven by direct-connected motors mounted on the machine. This eliminates the superstructure and overhead countershaft heretofore required for this grinder when motor-driven. The machine



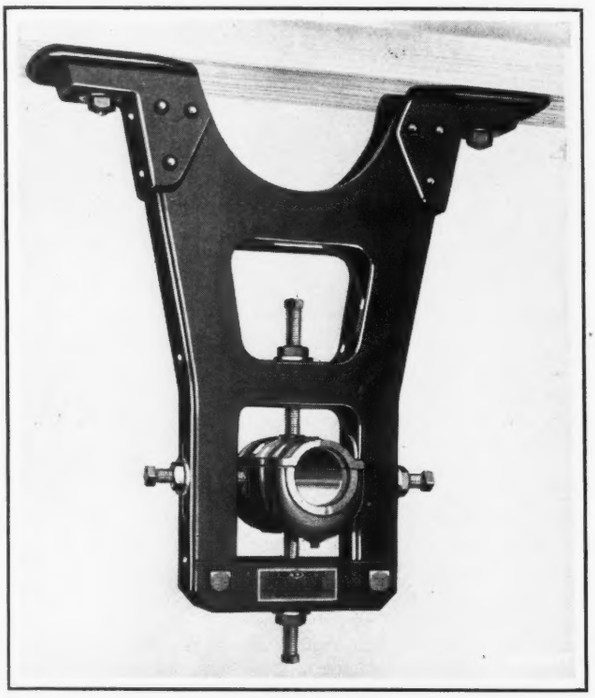
Wilmarth & Morman Motor-driven Universal Cutter and Tool Grinder

grinding spindle is driven by a ½-horsepower motor located on the top of the column, and the headstock is equipped with a ⅛-horsepower motor for revolving the work in performing cylindrical or internal grinding operations. Longitudinal power feed for the table is provided by a ¼-horsepower motor attached to the gear-box on the saddle. Of course, the latter motor is not furnished on a hand-feed machine.

It is mentioned that tests have shown a 50 per cent saving in power with a machine driven in this manner, and that there is less wear and tear on the gears in the feed-box, which are only in operation when the power feed is actually in use. Also, the floor space required for the machine has been reduced to less than one-half the space formerly necessary. Controlling switches are located on the knee below the table where they are always accessible. The machine, complete with motors and attachments, weighs about 1600 pounds. This new driving arrangement can be applied to all previously built grinders of this type.

DODGE SHAFT HANGER

An improved pressed-steel shaft hanger is being brought out by the Dodge Mfg. Corporation, Mishawaka, Ind. The frame is of box construction, welded and riveted together.

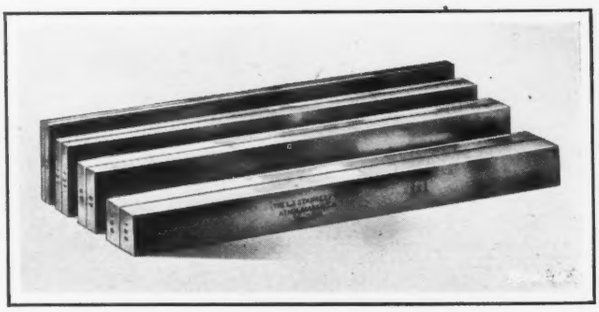


Dodge Improved Pressed-steel Shaft Hanger

Malleable iron feet of ample proportions provide a broad solid bearing. They extend downward a considerable distance on the frame to increase the rigidity of the hanger. The bearing may be lubricated by either ring or capillary oilers, and when equipped with rings these may be removed and capillary blocks substituted or vice versa. The hanger is finished with a special paint and embodies such features as lightness, strength, and convenience in erection.

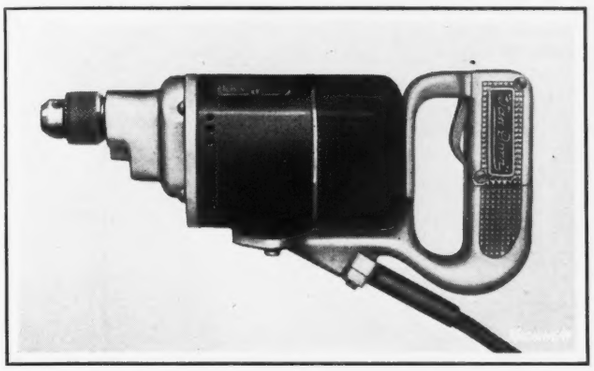
STARRETT PARALLELS

A recent addition to the line of precision tools made by the L. S. Starrett Co., Athol, Mass., consists of two sets of steel parallels. The No. 384 set is shown in the accompanying illustration. These parallels are made from a special



Starrett New Set of Tool-steel Parallels

grade of tool steel, hardened and ground, and in dimensions which experience has shown to make the most practical combinations. These two sets consist of eight pairs of parallels, which are furnished in individual pairs and combinations of pairs for the mechanic, or in complete sets for use in the tool-room or machine shop. All of these parallels are 6 inches long.



Van Dorn One-quarter-inch Portable Electric Drill

VAN DORN PORTABLE ELECTRIC DRILL

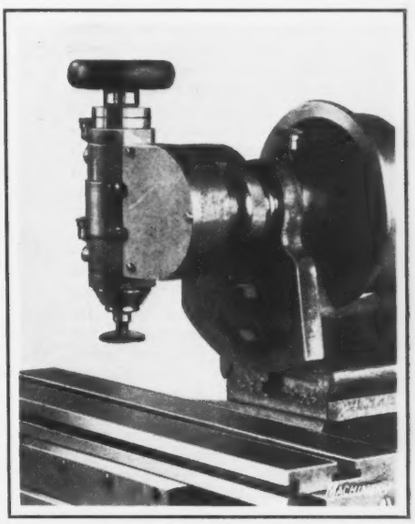
A new ¼-inch portable electric drill has recently been brought out by the Van Dorn Electric Tool Co., Cleveland, Ohio. The tool is intended for operation on either direct or alternating current. It is equipped with a removable grip handle which is provided with an automatic switch. The chuck is of the three-jaw type, and will take straight-shank drills up to ¼ inch. The speed of the tool with no load is 1500 revolutions per minute, and under full load, 800 revolutions per minute. The over-all length of the drill is 11 3/16 inches, and the weight, approximately 6 pounds.

ANDERSON SCRAPING MACHINE

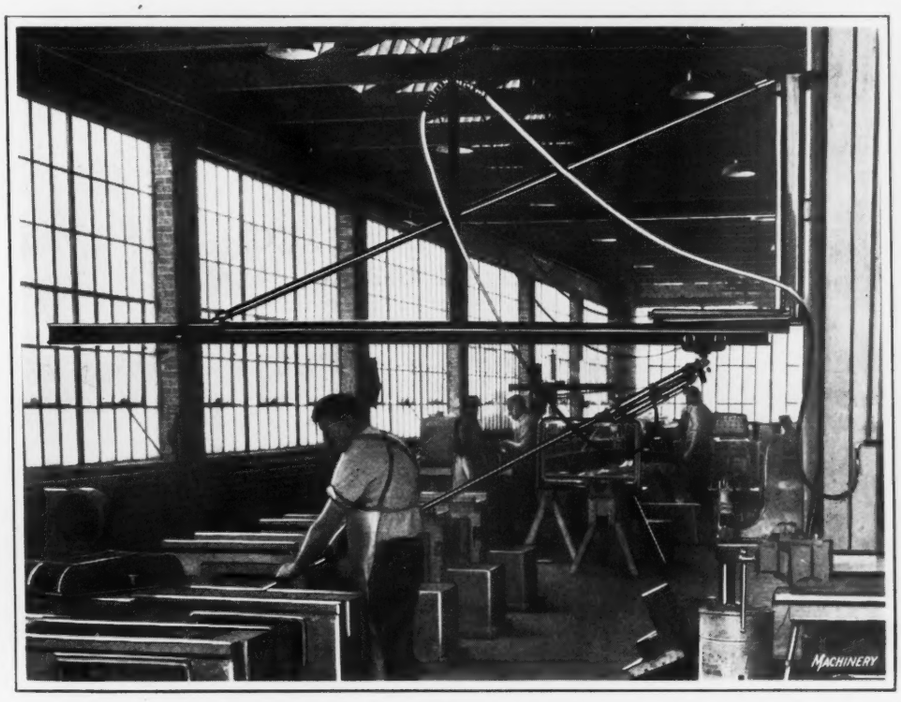
A new scraping machine, known as the "Jib Type" scraper, which permits the operator to scrape work within a radius of 18 feet, has been brought out by the Anderson Bros. Mfg. Co., 1910 Kishwaukee St., Rockford, Ill. The illustration shows this equipment in use, and indicates how a man can scrape a number of castings with the scraping machine mounted in one position. As shown, a 12-foot beam is provided, along the full length of which the trolley may travel. The trolley is automatically locked to the beam as soon as the throttle is pushed forward to allow air to enter the scraper ram for driving the scraper forward; in this way the scraper ram obtains a rigid support. The I-beam is mounted on a vertical shaft supported on ball bearings, so that the beam swings from side to side very easily. The whole arrangement may be easily mounted on a pillar, post, or wall. A man can scrape work first in one direction and then, by swinging the beam over, in another direction, thus cross-scraping without moving the work. This is a great advantage over former machines, as it is not necessary to use a turntable as a means for turning the work quickly for cross-scraping.

STARK VERTICAL MILLING ATTACHMENT

The bench milling machine made by the Stark Tool Co., Waltham, Mass., and any of the six sizes of lathes built by this company, with the exception of No. 2, may now be equipped with the vertical milling attachment illustrated. The spindle of this attachment may be swung 15 degrees either side of the perpendicular. It is machined to receive No. 3 Stark collets which have a maximum capacity of ⅜ inch, as well as taper collets and arbors. The spindle is driven through helical gears which have a ratio of 2 to 1, and therefore is driven at twice the speed of the machine spindle. The length of the spindle on all sizes of the attachment is 5½ inches, and the distance from the lathe headstock to the center of the spindle, 3½ inches. The weight ranges from 10 to 13 pounds for the different sizes.



Stark Vertical Milling Attachment



Anderson "Jib Type" Scraping Machine which permits Work to be scraped within a Radius of 18 Feet

* * *

The general business activity of the country is reflected in the transportation field. Car loadings are maintained at a high level, and the reports of the regional shipping boards all indicate increased traffic over last year, the middle-western territories showing as much as a 15 per cent increase. Deliveries of equipment continue heavy, and orders for additional equipment are being placed. Toward the end of February, 125,000 surplus freight cars were available.

BROWN & SHARPE MACHINES

BROWN & SHARPE PRODUCTS

Milling Machines
Grinding Machines
Gear Cutting Machines
Screw Machines
Machinists' Tools
Cutters and Hobs

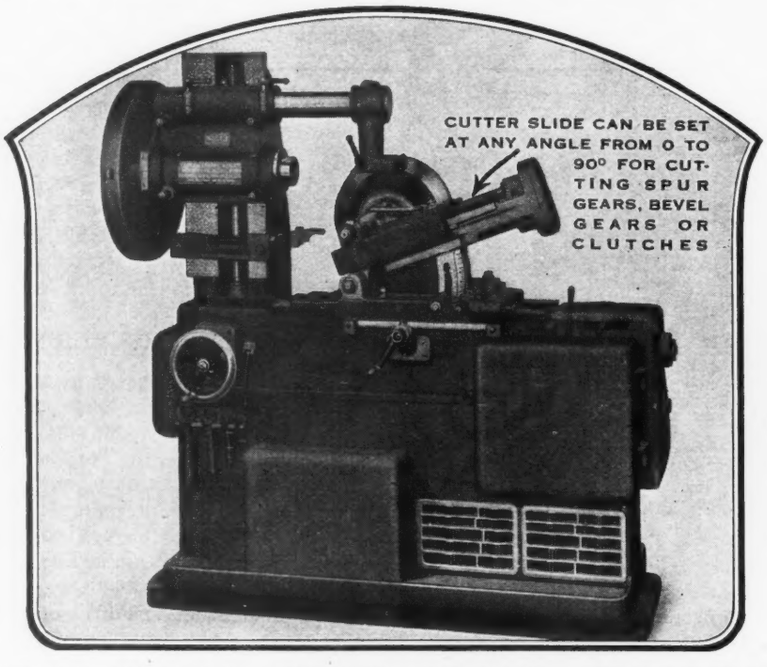
WORLD'S STANDARD FOR QUALITY

ADAPTABILITY

The adaptability of Brown & Sharpe Products to a wide range of work springs from the close acquaintance of our designers with modern manufacturing requirements. Our long experience as manufacturers has clearly shown us the value of adaptability. But in no case have we sought for adaptability at the expense of accuracy and strength. In designing Brown & Sharpe Products, strength, accuracy, and reliability are the first considerations. Adaptability must be in keeping with these essential qualities. This principle makes certain that Brown & Sharpe Products will give satisfactory results on every type of work to which they are suited.



This catalog lists our complete line of gear cutting machines including five sizes for cutting Spur Gears and two sizes for Spur and Bevel Gears. Write today for a copy of our General Catalog No. 137.



SPUR GEARS—BEVEL GEARS—CLUTCHES

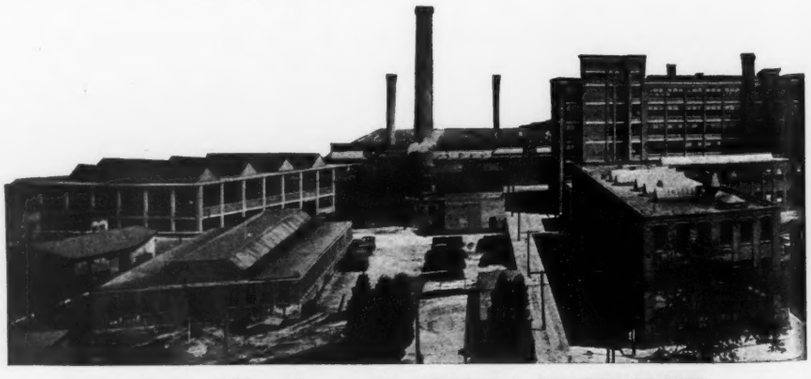
Cut them all on this one machine

An engineer once described the Brown & Sharpe No. 13 Automatic Gear Cutting Machine as "an automatic milling machine with an extremely accurate automatic indexing mechanism." This description is along the right lines; it gives an excellent idea of the possibilities of this machine.

Having a cutter slide which can be moved through an arc of 90°, this No. 13 Gear Cutting Machine cuts Spur Gears, Bevel Gears and Clutches. For the average shop this handy machine should prove a good investment; it handles Spur Gears and Bevel Gears to 18 in. in diameter with a 4 in. face up to 6 diametral pitch for steel and 5 for cast iron. A larger size, No. 13 Heavy, takes gears to 24" diameter, 6" face; 4 D.P. for steel and 3 for cast iron.

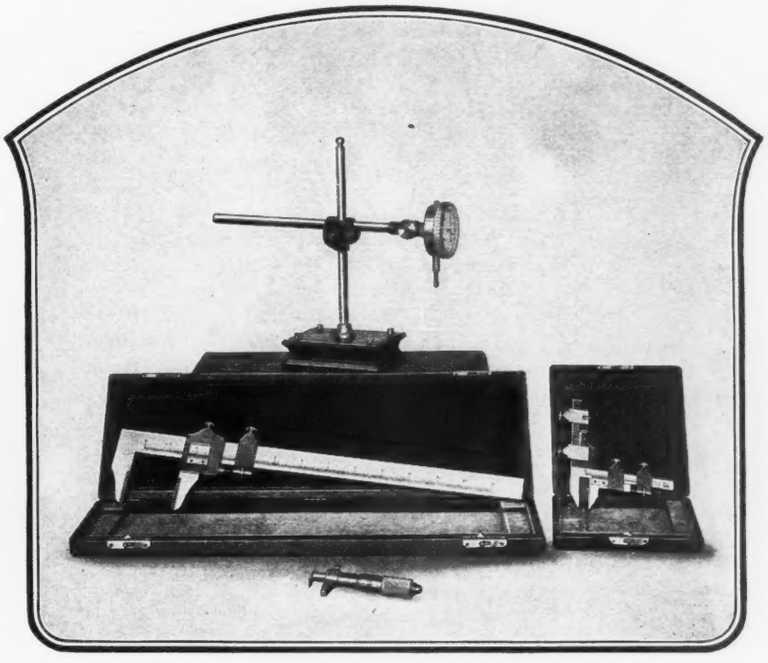
The ability of these machines to mill accurate clutches and similar work is a convenience soon appreciated by every shop which installs them. Catalog No. 137 gives specifications—write for your copy today.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.



32 Acres of Floor Space—The BROWN & SHARPE PLANT

BROWN & SHARPE TOOLS





A Dial Test Indicator is a tool of a thousand uses. In setting up gears, in testing shafts for run-outs, in inspecting work, a Dial Test Indicator combines convenience with accuracy. Brown & Sharpe Dial Test Indicators are made in several sizes, all described in our Small Tool Catalog.

Supply Your Gear Makers with Brown & Sharpe Tools

These four Brown & Sharpe Tools are a great help in cutting accurate gears. For accurately measuring the blank and bottom diameter of gears, furnish your tool-room with Vernier Caliper No. 573. For scribing blanks to show the extreme depth of teeth, supply your men with Gear Tooth Micrometer No. 249.

In setting up large gears a Dial Test Indicator is essential. Several styles are listed in our Small Tool Catalog. For accurately measuring the size of teeth when starting to cut a blank your men can rely on Gear Tooth Vernier No. 580. To help your men make better gears, provide your tool-room with these Brown & Sharpe Tools. Write today for Catalog No. 28.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.



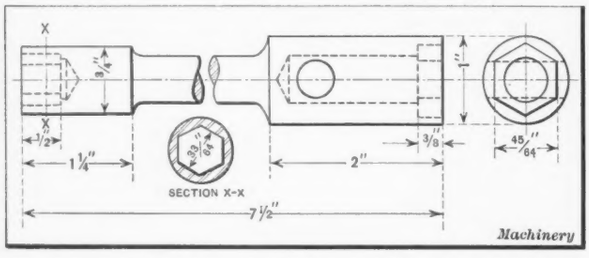
This catalog is our silent salesman; he shows our complete line of small tools. He calls at your request and allows you to make your own selections, at your own convenience. If you would like to see our complete line of tools, write today for Catalog No. 28.



PROVIDENCE, R. I., U. S. A.—90 Years of Experience.

EXAMPLE OF HEXAGON DRILLING

The accompanying illustration shows a hexagon socket wrench having a 45/64-inch hexagon hole, 3/8 inch deep, in one end, and a 33/64-inch hexagon hole, 1/2 inch deep, in the other end. An interesting feature about these wrenches is that the holes, instead of being hand-drifted as was the custom in the past, are being drilled by the method for producing holes in the shapes of polygons developed by Watts Bros. Tool Works, Turtle Creek, Pa. Owing to the special design of the wrenches, they could not be



Socket Wrench in which Two Hexagon Holes are drilled

broached in a satisfactory manner, so the choice was between hand-drifting or drilling.

These wrenches are worked up in lots of 100. The total cost for labor when hand-drifting the holes was $39.60. In addition, about 10 per cent of the parts had to be scrapped because of the holes breaking out, due to the excessive stress created in drifting the holes. This loss also involved the loss of time consumed in turning the blanks and in preparing for the hexagon hole drifting operation.

The total labor cost for the same operation on 100 wrenches when drilled to hexagonal shape, using the floating chuck and drills in an engine lathe, was $3.15, and there was no loss from scrapped work. Hence, in this case, there was a total saving on labor alone of $36.45 per 100 wrenches, not counting the 10 per cent loss in scrap. The total cost of the floating chucks and drilling tools was slightly less than $65. The drills will produce at least 4000 or 5000 holes before they are worn out, and they can be replaced at a cost of slightly less than $19. The saving due to the use of modern machine equipment is obvious, and is only one more example added to those previously placed on record in MACHINERY relating to savings accomplished by the use of improved tools.

* * *

RACKS FOR HOLDING PLANER ACCESSORIES

The accompanying illustration shows a neat and efficient way in which to care for such planer accessories as bolts, plugs, and studs. The photograph was taken in the plant of the Newark Gear Cutting Machine Co., Newark, N. J., and shows racks which are attached to all the planers in this shop for holding planer accessories. The reason for providing every planer with a full set of bolts, plugs, studs, and blocks is to save time, as each man in the planer department will readily find all that he needs in the way of accessories. In addition, all around the planer room there is a continuous shelf upon which are placed straps and other holding devices ready for use. In this way the planing time on a job does not need to include a great deal of time lost by the operator looking around for straps, bolts, and other holding means.

* * *

An aeronautical engineering meeting will be held in Dayton, Ohio, October 3, by the Society of Automotive Engineers at the time of the international air meet and Pulitzer race.

S. A. E. MACHINE TOOL EXHIBITION

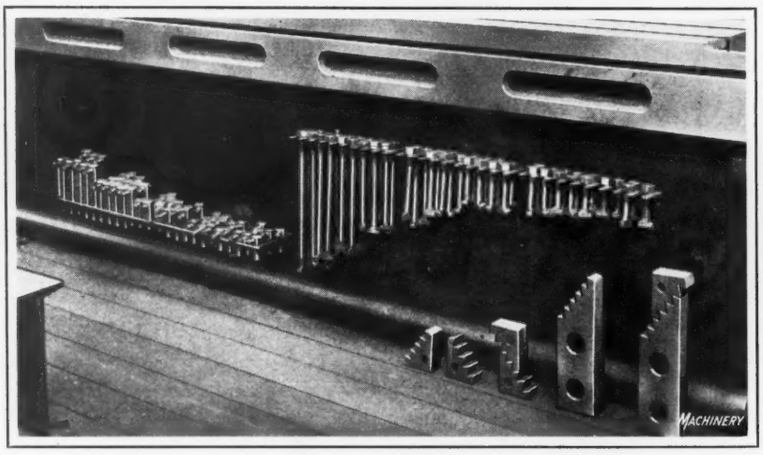
If present plans materialize, an exhibition of machine tools and production equipment will be held in conjunction with the national production meeting of the Society of Automotive Engineers next fall. This meeting and exhibit will be held in the General Motors Building at Detroit, October 21 to 25. It is probable that the sessions themselves will be confined to two days of this period, the remainder of the time being given over to the exhibition, factory visits, and the convention of the National Machine Tool Builders' Association.

The purpose of the exhibition is purely an educational one. There have been many requests that the Society of Automotive Engineers sponsor such an exhibition for the convenience of its members who come to the production meeting anxious to hear about, see, and inspect new manufacturing equipment, processes, and methods. It is hoped to attract to the exhibit those manufacturers who wish to display new tools, conveying machinery, painting and enameling equipment, labor-saving devices, materials, and in fact anything that will appeal to the automotive production executives. Efforts will be made to have most of the exhibits under power or otherwise demonstrated.

* * *

FOREIGN TRADE CONVENTION

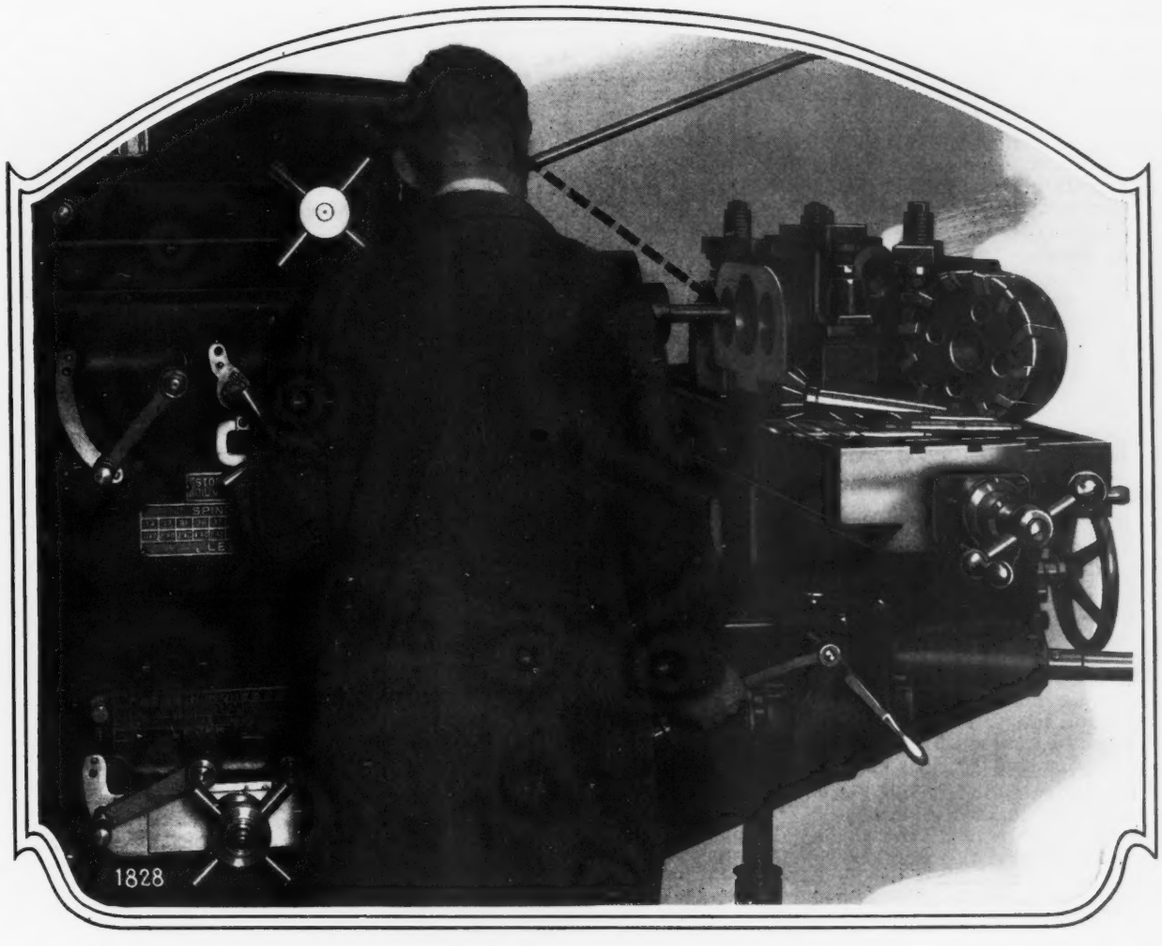
The theme of the national foreign trade convention which will be held at Boston, Mass., June 4, 5, and 6, will be "Our Need for Wider Markets," and the sessions will include something of interest to practically every manufacturer engaged in foreign trade. The program will cover such subjects as: education for foreign trade; banking facilities for foreign trade; problems of the export manager; reports on world trade conditions, with special emphasis on non-European markets; reports on American foreign trade policies, by a special committee of the National Foreign Trade Council; transportation; direct selling; importing problems considered in connection with exports; foreign credits and credit information; and advertising for foreign trade. The merchant marine problem will also be dealt with in a separate session. Further information can be obtained from the secretary of the National Foreign Trade Council, India House, Hanover Square, New York City.



Convenient Method of holding Planer Accessories

* * *

A departure in engineering education which is becoming more and more important, especially in big industrial centers, is the summer courses that are now being offered. The Carnegie Institute of Technology will give a wide range of engineering courses of six and eight weeks, beginning June 16. These will include chemistry, physics, mechanics, engineering drawing, descriptive geometry, surveying and coal mining.



Clear Vision Means Clear Profits

FOLLOW the dotted line—the line of *clear vision.* Rear control of the feeds (note operator's right hand on rear feed control lever) on Cincinnati No. 2 and No. 3 High Power Millers makes jobs like these possible.

Clear vision means accurate work—less spoilage of work—less time per piece—greater production.

Clear vision adds to the confidence of the operator.

Rear control, however, is only *one* of many valuable features which make these rectangular overarm Cincinnati millers ideal, not only for tool-room work but for production in the shop as well.

We have a special booklet fully describing these machines. Send for your copy.

THE CINCINNATI MILLING MACHINE COMPANY

CINCINNATI *Established 1884* **OHIO, U. S. A.**

CINCINNATI MILLERS

TRADE NOTES

NILES-BEMENT-POND Co., 111 Broadway, New York City, announces that its Pittsburg office was moved from 425 Seventh Ave., to 503 Liberty Ave., Empire Building, on April 1.

TRIUMPH ELECTRIC Co., Cincinnati, Ohio, announces a complete revision of prices covering its entire line of motors, both alternating and direct current, from 1 horsepower to 250 horsepower, effective March 1.

WESTCOTT CHUCK Co., Oneida, N. Y., recently elected the following officers: President, Mrs. C. R. Baker; vice-president and general manager, A. Parker Barnaskey. T. F. Hand will continue as secretary and treasurer, and J. Westcott as factory manager.

GURNEY BALL BEARING Co., Jamestown, N. Y., has been purchased by the MARLIN-ROCKWELL CORPORATION, New York City. The combined plants will be operated under the direction of H. K. Smith, president of the Gurney Ball Bearing Co. The Marlin-Rockwell Corporation has a plant at Plainville, Conn.

CLEVELAND STONE Co., Cleveland, Ohio, announces the removal of the offices of the Sterling Grinding Wheel Co. from Tiffin, Ohio, to Cleveland on April 1. About two years ago the Cleveland Stone Co. acquired the Sterling Grinding Wheel Co. The offices are being removed in order to provide improved grinding service for the company's customers.

COGSDILL MFG. Co., 6511 Epworth Blvd., Detroit, Mich., manufacturer of the "Cogsdrill," has purchased all the stock of the GRINDING PROCESS TOOL Co., of which S. A. Cogsdill has been president since its inception. The Grinding Process Tool Co. is moving into the new factory of the Cogsdill Mfg. Co. Business will be continued in the name of the Grinding Process Tool Co. until the end of this year.

REED-PRENTICE Co., Worcester, Mass., has established an office in Chicago located at 204 Machinery Hall, to handle direct sales in the Chicago territory. Lane Scofield is in charge of the new office. The company also announces the appointment of E. H. Warner as salesman for the Connecticut, western Massachusetts, New Hampshire and Vermont territory. Mr. Warner is located at 76 W. Alvord St., Springfield, Mass.

HEIM GRINDER Co., Danbury, Conn., a Connecticut corporation, was organized March 1, 1924, with the following officers: Henry N. Flynt, president; Clayton O. Smith, vice-president; Ferris M. Angevin, secretary and treasurer. This company has acquired the entire interest of the Ball & Roller Bearing Co. in the Heim centerless grinder, and will continue the manufacture of this machine in the present plant at Danbury, Conn.

DILLON BROS. Co., Wheeling, W. Va., a partnership of Friend E. Dillon and Charles E. Dillon, has been dissolved, and the DILLON BROS. MACHINE Co., an Ohio corporation having its principal office in Bridgeport, Ohio, has taken over the assets of the partnership. The new concern will continue the work of its predecessors, as general machinists and engineers. Charles E. Dillon will be secretary and treasurer, and Friend E. Dillon, general manager.

LANDIS MACHINE Co., INC., Waynesboro, Pa., manufacturer of thread-cutting machinery and thread-cutting die-heads, has recently decided to market the new Landis automatic die-head, for application to turret lathes and hand-operated screw machines, under the name of "Land-Matic" die-head. The reason for this is that there has been considerable confusion between the automatic die-head for turret lathes and screw machines, and the rotary die-head for application to bolt cutters, the appearance of which is somewhat similar.

DOEHLER DIE-CASTING Co., Brooklyn, N. Y., has acquired the die-casting department of the Light Mfg. & Foundry Co., of Pottstown, Pa. The plant will be operated under the name of the Light Mfg. & Foundry Division of the Doehler Die Casting Co., and will specialize in the production of zinc alloy die-castings. No change in policy is contemplated. The company has also acquired a new plant at Batavia, N. Y., which will specialize in the production of aluminum die-castings.

GENERAL ELECTRIC Co., Schenectady, N. Y., moved the headquarters of its East Central District from Cincinnati to Cleveland on March 1. The headquarters, as well as the local Cleveland office, are now located in the new Union Trust Bldg., in which the company will occupy more than 15,000 square feet of floor space.

OHMER FARE REGISTER Co., of Dayton, Ohio, has acquired the entire business of the American Taximeter Co., of New York City, manufacturer of recording devices for all kinds of transportation cars or vehicles. The business of the two companies will be concentrated at the plant of the Ohmer Fare Register Co., in Dayton, and additional machinery and equipment will be installed. The office, sales, service, and supply distribution headquarters for the eastern division of the Ohmer Fare Register Co. will remain in the Locomobile Building, at 16 W. 61st St., New York City.

DIEFENDORF GEAR CORPORATION, Syracuse, N. Y., has recently purchased the property at 920 W. Belden Ave., and has moved into its new quarters. The plant is of brick and steel construction, with cement floors. It consists chiefly of a large one-story factory building having approximately 25,000 square feet of floor space; a two-story ell, with approximately 10,000 square feet of floor space, containing the hardening room on the ground floor and a pattern shop on the second floor; and a three-story ell, with about 5000 square feet of floor space, having material storage in the basement, offices on the ground floor, and pattern storage on the third floor.

FOOTE GEAR WORKS, INC., 430 N. Oakley Blvd., Chicago, Ill., has been formed for producing cut gears for all purposes from cast iron, steel, bronze, rawhide, or bakelite. Bradford Foote is president and treasurer; G. Gunderson, vice-president; and M. A. White, secretary. Mr. Foote was formerly associated with his brother John B. Foote (who died somewhat over a year ago) in the Foote Bros. Gear & Machine Co., Chicago, Ill., but last September he sold his entire interest in this company, resigning as a director and general manager. He has now purchased the entire equipment, good will, and trade name of the Crofoot Gear Works, Boston, Mass., and has moved the machinery to the location of the present factory at 430 N. Oakley Blvd., Chicago, which is now ready for production.

OBITUARIES

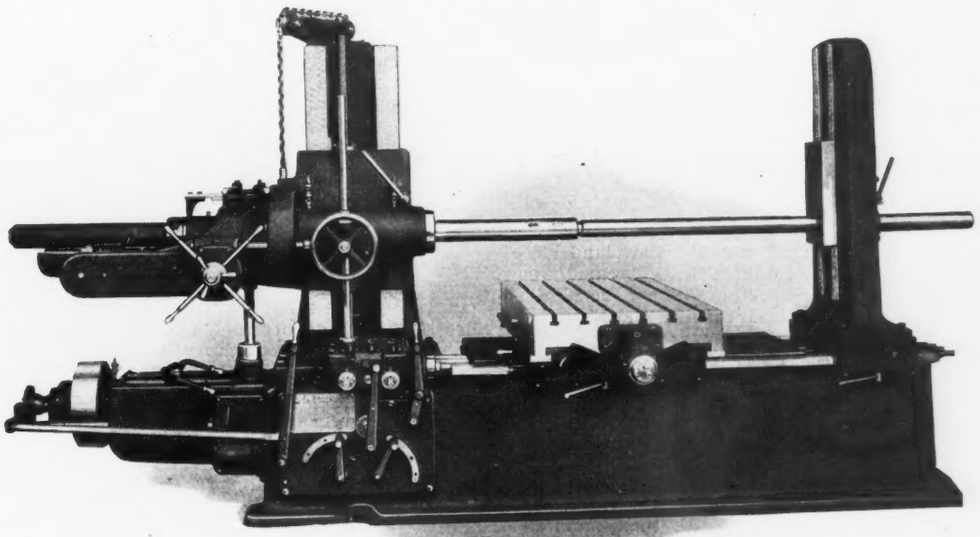
GEORGE ROBERT BUSHER, the oldest of the salesmen of the Chicago Belting Co., died Friday, February 29, at his home in Chicago. Mr. Busher was born in 1864 in Buffalo, N. Y., and had been with the Chicago Belting Co. for eighteen years—since May, 1906. He covered a number of the middle-western states.

NORMAN E. ZUSI, president and manager of the Meisselbach-Catucci Mfg. Co., Newark, N. J., died March 21, after an illness of over two months, at the age of forty-one. Mr. Zusi was a graduate of Stevens Institute of Technology. He had been connected with the Meisselbach-Catucci Mfg. Co. since the foundation of the company, having been manager since 1910 and president since 1913. His genial disposition won for him many friends, who feel his loss keenly.

H. D. MEGARY, managing director of the Consolidated Pneumatic Tool Co., of London, England, died suddenly in London on March 20. Mr. Megary was born in Philadelphia April 21, 1888. He attended school in that city, and graduated from the University of Pennsylvania in 1909. Following his graduation, he became affiliated with the Bethlehem Steel Co., remaining with that company until June, 1918, when he became connected with the Chicago Pneumatic Tool Co. as assistant to the president, later being made secretary of the company. In 1921 he was transferred to London to assume the duties of managing director of the English company. He was also director of European sales.

EDMOND B. ROBERTS, a vice-president and secretary of Henry Disston & Sons, Inc., Philadelphia, Pa., died at his home in Philadelphia, on February 22, aged forty-eight years. Mr. Roberts' health had been failing for some time, but he had been absent from the office only three weeks before he died. His death was due to bronchial pneumonia. Mr. Roberts was born in Philadelphia on September 17, 1875. He went to the Disston organization as an office boy in 1890, at the age of fifteen years, but his ability soon won for him promotion to the position of assistant to the secretary of the company. In 1908 he was appointed assistant secretary, and in 1914 was made secretary and a vice-president of the company, in which capacities he served until his death. Mr. Roberts' work had to do principally with the financial affairs of the corporation. He became a prominent figure in manufacturing circles, taking an active part in movements to promote better conditions in manufacturing, and in improving trade conditions. He had many friends in the hardware, lumber, and steel industries. He is survived by his widow, and a brother, Elmer S. Roberts.

"It is easy enough to be wise after the event"



One customer who hesitated for considerable time because he thought he "wouldn't be able to keep it running" found so many customers who wanted their work done on a

"PRECISION"

Boring, Drilling and MILLING MACHINE

that he had to buy another and larger one.



WE ALSO MAKE THE

LUCAS POWER Forcing Press

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich, V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo.

PERSONALS

H. D. SMITH is now representing the Colonial Steel Co. of New Haven, Conn., as salesman in the western half of the state of Connecticut.

W. L. GOODRICH and W. H. RIEGER have been appointed special representatives of the Colonial Steel Co., Pittsburg, Pa., for die-block, shoe, and trimmer steel.

C. J. PRIEBE, for the last four years engaged on editorial and advertising work for the *American Machinist*, has recently joined the sales organization of the Keller Mechanical Engineering Corporation, Brooklyn, N. Y.

G. J. HAWKEY, of the Cleveland Duplex Machinery Co., is now representing the Reed-Prentice Co., Worcester, Mass., in the Cleveland territory, for all types of standard and special machinery pertaining to the automotive industry.

A. D. BACH, formerly connected with the Cleveland office of the Atlas Steel Corporation, Dunkirk, N. Y., became associated on March 1 with Henry Disston & Sons, Inc., Philadelphia, Pa., in connection with steel sales in the New England territory.

R. F. JUDISCH, who for the last four years has been production manager and plant manager of the Canadian plant of the Hoover Co., located at Hamilton, Ontario, has been placed in charge of the Canton, Ohio, plant of the company in the capacity of superintendent.

T. R. HARRISON has been placed in charge of the Research Department of the Brown Instrument Co., Philadelphia, Pa. Mr. Harrison was formerly associated with the Pyrometry Department of the Bureau of Standards and more recently with the Champion Porcelain Co. of Detroit, Mich.

FRED J. MILLER, Center Bridge, Pa., past-president of the American Society of Mechanical Engineers, has been appointed a member of the Public Service Commission of Pennsylvania by Governor Pinchot. Mr. Miller will conduct a survey of the electrical power service of the state.

C. E. REESE, gas and electrical engineer, has been appointed general manager of the Bluefield Gas & Power Co., Bluefield, W. Va. He was formerly connected with the Westinghouse Electric & Mfg. Co., as section head of the stoker sales and publicity department in Philadelphia.

WALTER W. WILLIAMSON has joined the sales organization of the Chicago Belting Co., Chicago, Ill., in the capacity of special factory representative in the state of Texas. Mr. Williamson was formerly connected with the Briggs Weaver Machinery & Supply Co., of Dallas. His offices will be at 838 Wilson Bldg., Dallas, Tex.

CHARLES C. WALSH has been appointed Detroit representative of the Falk Corporation, Milwaukee, Wis., to handle Falk herringbone gears and Falk-Bibby couplings. Mr. Walsh's headquarters will be at 1500 Real Estate Exchange Bldg., Detroit. His territory will include the state of Michigan and northwestern Ohio.

E. C. MYERS has been appointed representative in San Francisco for the Falk Corporation, of Milwaukee, Wis., to handle Falk herringbone gears and Falk-Bibby couplings. Mr. Myers' headquarters will be at 320 Rialto Bldg., San Francisco, and his territory will include the states of California, Oregon, and Washington.

S. A. EMERY, formerly eastern manager of the Dodge Mfg. Co. and for twenty years associated with that company, has joined the sales force of the Royersford Foundry & Machine Co., Philadelphia, Pa. Mr. Emery will sell the entire Royersford line, including Sells and Royersford bearings, hangers, couplings, collars, and other transmission equipment.

H. A. SHIER, formerly district sales manager at Pittsburg, Pa., for the Onondaga Steel Co., Syracuse, N. Y., has been made district sales manager at Pittsburg for the steel sales department of Henry Disston & Sons, Inc., Philadelphia, Pa. Mr. Shier represented the Onondaga Steel Co. for eight years, and prior to that was with the Bethlehem Steel Co. for eight years, in its tool steel sales department.

COMING EVENTS

APRIL 10-11—Annual convention of the Sales Executives' Division of the American Management Association at Hotel La Salle, Chicago. Secretary's office, 20 Vesey St., New York City.

APRIL 23-24—Twenty-sixth annual convention of the National Metal Trades Association in New York City; headquarters, Hotel Astor. National secretary, L. W. Fischer, Peoples Gas Bldg., Chicago, Ill.

APRIL 28-30—Annual meeting of the American Gear Manufacturers' Association at Buffalo, N. Y. Secretary, T. W. Owen, Room 107, 2443 Prospect Ave., Cleveland, Ohio.

APRIL 30-MAY 2—Eleventh convention of the Society of Industrial Engineers in Buffalo, N. Y. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago, Ill.

MAY 19-21—Joint convention of the Southern Supply and Machinery Dealers' Association, the National Supply and Machinery Dealers' Association, and the American Supply and Machinery Manufacturers' Association, in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary-treasurer, F. D. Mitchell, 1819 Broadway, New York City.

MAY 22-23—Spring sectional meeting of the American Society for Steel Treating at Moline, Ill., with headquarters at the LeClaire Hotel. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

MAY 26-29—(instead of 19-22)—Spring meeting of the American Society of Mechanical Engineers at Cleveland, Ohio. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 4-6—Eleventh annual foreign trade convention in Boston, Mass. O. K. Davis, India House, Hanover Square, New York City, secretary.

JUNE 11-18—Convention and exhibit of Section V Mechanical, of the American Railway Association in Atlantic City, N. J. Secretary, V. R. Hawthorne, 431 S. Dearborn St., Chicago.

JUNE 11-18—Convention and exhibit of the Railway Supply Manufacturers' Association in Atlantic City, N. J. Secretary, J. D. Conway, 1841 Oliver Bldg., Pittsburg, Pa.

JUNE 23-27—Twenty-seventh annual meeting of the American Society for Testing Materials, in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

JUNE 24-27—Summer meeting of the Society of Automotive Engineers at Hotel Monmouth, Spring Lake, N. J. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

JUNE 30—JULY 12—World power conference in London, England, at the British Empire Exhibition, in cooperation with technical and scientific institutes and industrial organizations. Further information may be obtained from Calvin W. Rice, secretary of the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

SEPTEMBER 22-26—Sixth convention and international steel exposition of the American Society for Steel Treating, in Boston. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

SEPTEMBER 24-25—Automotive transportation meeting at the Society of Automotive Engineers' headquarters, Engineering Societies' Bldg., 29 W. 39th St., New York City. Coker F. Clarkson, secretary.

OCTOBER 3—Aeronautic meeting of the Society of Automotive Engineers at Dayton, Ohio. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

OCTOBER 13-18—Twenty-eighth annual convention and exhibit of the American Foundrymen's Association in Milwaukee, Wis. Secretary, C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill.

OCTOBER 21-24—Production meeting and machine tool exhibition of the Society of Automotive Engineers at Detroit, Mich. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

NOVEMBER 18-19—Service engineering meeting of the Society of Automotive Engineers at Cleveland, Ohio. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

DECEMBER 1-6—Third National Exposition of Power and Mechanical Engineering in the Grand Central Palace, New York City.

NEW BOOKS AND PAMPHLETS

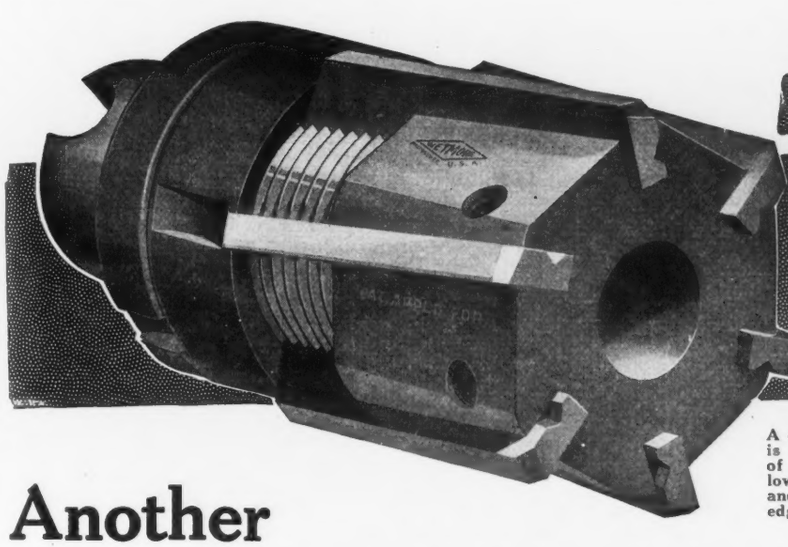
THE ENAMELED WIRE SYSTEM. 8 pages, 6½ by 8 inches. Distributed by B. C. Chatterjee, head of the Department of Electrical Engineering, Benares Hindu University, Benares, India.

STANDARD PRACTICAL PLUMBING. By R. M. Starbuck. 432 pages, 6 by 9 inches; 364 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $3.50.

This is the seventh revised and enlarged edition of an exhaustive treatise on all branches of plumbing construction including drainage and venting, ventilation, hot and cold water supply and circulation. The text has been revised to bring the methods up to date, and new illustrations have been added. One of the new chapters gives helpful information on examinations that must be passed by plumbers and fitters.

MECHANICAL WORLD ELECTRICAL POCKET BOOK (1924). 326 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 1 shilling, 6 pence.

The present edition of this well-known little handbook contains several new and important features. The section on accumulators has been entirely rewritten and the latest developments included. A lengthy section has been added on testing sets, descriptive of the various instruments employed in the latest practice. Other parts that have been rewritten are those relating to electric lamps and lighting, electricity in ships, and electric welding. New sections have been included on electric furnaces and on thermionic valves.



Note this Advantage

A distinctive feature of this Wetmore Shell Reamer is the 1/8" projection of the blades over the end of the reamer body for chip clearance. This allows the chips to fall off ahead of the reamer body and prevents chips from clogging up along cutting edge of blades.

Another WETMORE REAMER that Cuts Production Costs

Here is the famous *Wetmore Expanding Shell Reamer*, the reamer that helped so many production men turn out more work at less cost—and in less time—during the rush periods of 1923.

Now, again—this is one of the most popular of the Wetmore line. It is turning out job after job that other reamers have fallen down on. More than one user has told us that this Wetmore Shell Reamer has done work which they thought would stump any reamer.

That's why we say: The *Wetmore Expanding Shell Reamer* is guaranteed, absolutely, to lower your production costs. It does quicker work—the reamer stands up longer—blade replacement costs are cut.



WETMORE
Replacement Blades

The method of holding the blades on the Wetmore Shell Reamer eliminates unnecessary extra parts. This saves time and simplifies the replacement and adjustment of blades.

All Wetmore blades are scientifically ground for working various metals—steel, cast iron, bronze, etc. Best high-speed steel, ground to thickness, length and on seat. Tested for hardness and toughness. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron or bronze.

This Wetmore Shell Reamer is adaptable for either line or pilot reaming. Fits all standard bars and shell reamer arbors. Body, lock nut and cone nut are finest heat-treated alloy steel. Has .087" expansion. Made in these sizes: 1¼" to 3", 6 blades; 3 1/16" to 5", 8 blades; 5 1/16" to 6", 10 blades. Larger sizes made on order. Made also with straight hole, if desired. Left-hand blades are staggered to eliminate chattering.

Send for FREE Catalog.

Write for Wetmore Catalog, showing full line of standard, heavy duty, shell, small machine and cylinder reamers. Also arbors and replacement blades. Sent *free, postpaid*—no obligation to you.

WETMORE REAMER COMPANY
MILWAUKEE, WISCONSIN

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

NEW CATALOGUES AND CIRCULARS

HILL, CLARKE & CO., 649 W. Washington Blvd., Chicago, Ill. Detailed list of remanufactured machine tools in stock.

S. F. BOWSER & CO., INC., Fort Wayne, Ind. Circular illustrating and describing Bowser gasoline pumps and oil tanks for use in factory garages.

STERLING WATCH CO., INC., 15 E. 26th St., New York City. Leaflet containing illustrations showing the wide field of application of the Pastor stop-watch.

TRIUMPH ELECTRIC CO., Cincinnati, Ohio. Circular descriptive of tests made on the 10-horsepower TR self-starting polyphase induction motor made by this concern.

AMERICAN BLOWER CO., Detroit, Mich. Bulletin 1018, descriptive of the "Venturafin" unit heater, a new compact apparatus for heating industrial buildings, warehouses, etc.

STARK TOOL CO., Waltham, Mass. Bulletin C, illustrating and describing the Stark milling attachment with dividing head and cutter-arbor, as well as the Stark vertical milling attachment.

JONES & LAMSON MACHINE CO., Springfield, Vt. Circular descriptive of Flanders ground taps, outlining the reasons why ground taps are desirable, and giving tables of sizes carried in stock.

FOXBORO CO., INC., Neponset Ave., Foxboro, Mass. Circular describing the Foxboro improved helical tube movement provided in the recording thermometers, gages, and other instruments made by this concern.

BAUSCH & LOMB OPTICAL CO., Rochester, N. Y. Circulars descriptive of the Bausch & Lomb compound pocket microscope; convertible substage lamp for microscopes; and B & L colorimeters and accessories.

NEW DEPARTURE MFG. CO., Bristol, Conn. Sheet No. 160-E for loose-leaf binder, illustrating and describing the application of New Departure ball bearings in a horizontal boring, drilling, and milling machine.

CROUSE-HINDS CO., Syracuse, N. Y. Circular illustrating condulets of the F S series, for switch and plug receptacle outlets. These condulets permit the mounting of two, three, or four wiring devices in the same body.

REVOLVATOR CO., 343 Garfield Ave., Jersey City, N. J., manufacturer of the "Revolvator" lift truck, is distributing a calendar for 1924, which illustrates the "Revolvator" lift truck and "Revolvator" barrel racks in use.

ROOT CO., Bristol, Conn., manufacturer of automatic counters, has issued a book entitled "Formula of Facts, Figures and Facilities for Finding Faulty Figures in Production Costs," dealing with the counting of all classes of products.

TIDE WATER OIL SALES CORPORATION, 11 Broadway, New York City. Book entitled "Power Plant Lubrication," containing a treatise on the basic principles of lubrication as applied to prime movers and auxiliary machines in the power field.

GOULD & EBERHARDT, Newark, N. J. Bulletin 120, containing setting up instructions for Gould & Eberhardt shapers. Bulletin 123, entitled "G & E Shapers. Why it Pays to Buy Them," illustrating and describing the various important features incorporated in these shapers.

TAFT-PEIRCE MFG. CO., Woonsocket, R. I. Circular illustrating and describing the Taft-Peirce micrometer plug gage for tool-room use, machine production, and inspection. The details of construction are illustrated by a line engraving, and price lists for the different sizes are included.

CHAMPION PNEUMATIC MACHINERY CO., 8164 S. Chicago Ave., Chicago, Ill. Catalogue 16, illustrating and describing Champion air compressors for service stations, garages, tire shops, and various industrial requirements. Complete specifications of both the single- and two-stage types are given.

CHARLES PARKER CO., Meriden, Conn. Pocket-size vise catalogue No. 57-A, illustrating the various types of vises made by this concern, and showing in blueprint form the features of construction. Dimensions and prices are given for the complete line, and a full list of repair parts is included.

J. W. PAXSON CO., Nicetown Lane and D St., Philadelphia, Pa. Bulletin 43, superseding No. 28, illustrating and describing the complete line of sand-blast machinery made by this concern, which includes sand-blast rooms, barrels, tables, cabinets, and hose machines, as well as dust collectors and accessories.

ANDERSON BROS. MFG. CO., Rockford, Ill. Bulletin illustrating and describing the Anderson pneumatic scraper—a machine designed solely for scraping bearing surfaces—which may be handled as though it were a hand scraper. The illustrations show the machine in use on different kinds of work.

WILSON-MAEULEN CO., 383 Concord Ave., New York City. Circular descriptive of the Rockwell direct-reading hardness tester, which is a precision machine, made in three sizes, for testing pieces up to 2¼, 4, and 7 inches in thickness, respectively. A partial list of users is included in the pamphlet.

VAN DORN ELECTRIC TOOL CO., Cleveland, Ohio. Circular illustrating and describing the new ¼-inch portable electric drill made by this concern. The illustrations show this drill in actual use in automotive shops, woodworking plants, railroad shops, maintenance and repair work, grinder service, and mining service.

BARNES DRILL CO., 814 Chestnut St., Rockford, Ill. Catalogue illustrating and describing the Barnes No. 263 self-oiled all-geared sliding-head drilling and tapping machines. These two machines are of essentially the same design except that the tapping machine is equipped with an automatic reversing mechanism.

ELECTRIC POWER CLUB, B. F. Keith Bldg., Cleveland, Ohio, has just brought out the third edition of its "Transformer Standards." Several new standards are included in this edition. Copies of the booklet may be obtained either from the Electric Power Club or from manufacturers of power and distribution transformers.

WARREN WEBSTER & CO., Camden, N. J. Booklet entitled "Webster from the Air," containing a collection of aerial photographs of twenty-four representative American cities in which Webster systems of steam heating are employed. Photographs are also shown of representative industrial plants equipped with these heating systems.

WILLIAMS TOOL CORPORATION, Erie, Pa. Circular descriptive of the "Willie Williams" portable power pipe threading machine (with electric, belt or hand drive) for cutting off, threading, reaming, and chamfering pipe from ¼ to 2 inches inclusive and bolts from ½ to 1½ inches. Used as a power unit, it will thread and cut off pipe up to and including 8 inches.

JONES & LAMSON MACHINE CO., Springfield, Vt. Catalogue describing pictorially the Hartness screw thread comparator for inspecting screws rapidly and accurately by means of a projected shadow from a single thread. The booklet also contains a discussion of the advantages of this method of testing screw threads, and gives information on installing comparators, including prices.

GEOMETRIC TOOL CO., New Haven, Conn. Catalogue of Geometric screw cutting tools and machines, containing an introductory statement concerning the products of the company, including statistics of production, which is followed by a detailed description of the different styles of Geometric die-heads, taps, hollow milling tools, chaser grinders, chamfer grinding fixtures and threading machines. At the end of the book are given tables covering all the different classes of standard threads.

REED SMALL TOOL WORKS, Worcester, Mass. Condensed catalogue No. 5 (24 pages, 3 by 6 inches), illustrating and describing recent additions to the Reed line of micrometers. The catalogue includes tables of decimal and millimeter equivalents of parts of an inch, and gives simple instructions on how to read English and metric micrometers, for the benefit of students and apprentices. It also announces the service rendered by the Rolled Thread Die Co. Division of the Reed Small Tool Works.

BULLARD MACHINE TOOL CO., Bridgeport, Conn. Catalogue entitled "Mult-Au-Matic Actualities," containing data showing specific economies that have been effected in the performance of actual work by the use of Bullard "Mult-Au-Matics." Complete data relative to each job is given, including class of work, kind of material operated on, operations performed, and production time. The examples shown give a good idea of the scope and production possibilities of these machines.

DIAMOND MACHINE CO., Providence, R. I. Catalogue entitled "The Diamond on the Job," containing a large number of illustrations showing the Diamond heavy face grinding machine engaged on different classes of work. Data are included in each case relative to the nature of the parts handled, material, stock removed, and production. Bulletins 607, 610, and 611 containing illustrations and specifications covering the Diamond 30-, 18-, and 54-inch face grinding machines.

YALE & TOWNE MFG. CO., Stamford, Conn. Catalogue 21-M, covering the material-handling equipment made by this concern, which includes chain blocks, chain hooks, winches, hoists, sheaves, trolleys, cranes, trucks, etc. This catalogue is presented as a reference book for the use of the engineer, plant superintendent, architect, purchasing agent, and salesman. It contains complete details on the products mentioned, such as dimensions, weights, clearances, and lifting, lowering, and running speeds.

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill., is distributing a pictorial story of Ryerson steel service, giving a bird's-eye view of the plants and products of the company, as well as views in the various departments, showing the production of some of the many Ryerson steel products, and the uses to which they are put. Some of the industries represented in these pictures are the automobile industry, locomotive shops, machine tool plants, textile mills, structural engineering, shipbuilding, farming, etc.

GISHOLT MACHINE CO., 1300 E. Washington Ave., Madison, Wis. Series of five circulars illustrating and describing the Gisholt "Du-All" grinder, a portable machine for grinding both cylinders and pistons. Series of six circulars descriptive of a precision balancing machine for the accurate measurement and location of unbalance in rotative parts. Illustrations show the machine in use on various classes of work. Leaflets 1, 2, 3, and 4, containing information on the Gisholt direct-current transformer for obtaining low-voltage direct current from commercial lighting or power circuits. Leaflet descriptive of the Gisholt school which is maintained by this company for its customers in order to help them get the greatest possible production from Gisholt equipment.